AMERICAN
DYESTUFF REPORTER

VOLUME XXIII MARCH 26, 1934 NUMBER 7

Analysis of

Wool-Cotton Textiles*

By RALPH T. MEASE and DANIEL A. JESSUP

Abstract

The results of a study of several methods for the determination of cotton and wool in mixtures are presented. The inadequacy of some of the methods is shown, and a satisfactory procedure is described. In this method, sizing, finishing materials, and natural nonfibrous constituents of the textiles are removed by solvent extraction followed by digestion with a starch-hydrolyzing enzyme and washing. Wool is determined directly by weighing after removal of the cotton by carbonization with aluminum chloride. Cotton is determined directly by weighing after removal of the wool with potassium hydroxide. Results accurate within 1 per cent of the amount of total dry fiber present are readily obtainable by the method.

I. Introduction

As a result of the trade- practice conference of the knit-underwear industry held on May 26, 1930, a ruling was adopted by the Federal Trade Commission requiring that "the word 'wool' shall not be used in any way in the labeling, advertising, merchandising, or selling of knit underwear unless the percentage by weight of wool contained in the garment is stated."[1] Further, a commercial standard for "Wool and part-wool blankets" was established by the joint action of producers, distributors, and users, and became effective April 1, 1933. It provides for the labeling of part-wool blankets with the guaranteed minimum wool content.[2] These standardization activities suggested the need for a precise quantitative method of analysis for part-wool textiles.

In general, textiles made from mixtures of cotton and wool are composed of: (1) Wool fiber (protein); (2) cotton fiber (cellulose); (3) natural oils, waxes, and other constituents of the raw fibers which have not been removed completely in the course of manufacture of the textile; (4) oils, soaps, waxes, starches, clay and other materials which have been added, collectively termed sizing and finishing materials; and (5) degraded protein and cellulose resulting from chemical deterioration of the fibers before or during processing. The materials named under (3), (4), and (5) are included in the term "nonfibrous materials" subsequently used in this paper.

The usual procedure of the analyst called to determine the cotton and wool content of the mixture is to remove nonfibrous material from a weighted specimen of the textile, then to remove one of the fibers by chemical means, and finally to weigh the residue. The weight of the fiber which has been removed from the mixture is then determined by difference. Sometimes allowance is made for materials which are considered to be a normal or allowable part of the fiber but which are removed by the reagents.

Two procedures are in general use for the removal of nonfibrous constituents: One consisting in successive treatments with hydrochloric acid and sodium carbonate, here designated the "scouring" method; the other consisting in a treatment with a hydrolytic enzyme, or the "malting" method. The scouring method was prescribed until recently by the American Society for Testing Materials and for the testing of U. S. Government purchases of wool-cotton textiles.[3, 4] The malting method is the tentative-standard procedure of the American Association of Textile Chemists and Colorists for the determination of sizing, loading, and finishing materials in cotton textiles.[5] It has been shown to give more reliable results than the scouring method.[6]

Two methods are in use for the quantitative separation of the fibers after removal of nonfibrous materials. One depends upon the removal of the cotton either by solution in strong sulfuric acid or by carbonization with aluminum chloride. The other depends upon the removal of the wool by treatment with sodium- or potassium-hydroxide solution.

Few quantitative data have been published to show the effect upon wool protein or cotton cellulose of the various

*Reprinted from Journal of Research, Bureau of Standards.

reagents used to effect separation of wool and cotton fibers. It is known that cotton which has been treated with hydrochloric acid loses weight in the potassium-hydroxide solution used to remove wool. It is also known that wool absorbs sulfuric acid and other substances from solutions in which it is immersed. It seemed essential, therefore, to make a quantitative study of the methods for the analysis of wool-cotton textiles in order to establish on an experimental basis a procedure satisfactory for the new demands. That is the purpose of the work reported here.

II. Materials

The cotton used in most of the experiments to be described was prepared from "grey" cotton yarn, unbleached airplane cloth, and commercial sheeting, by the method of Corey and Gray for the preparation of high-grade cellulose.[7]

The cotton was extracted 6 hours in a soxhlet apparatus with ether and 16 hours with alcohol. It was allowed to dry in air at room temperature and was then extracted with a boiling 1-per cent solution of sodium hyrdoxide. This extraction was carried out in a 500 ml Erlenmeyer flask fitted with a siphon, and the extraction rate was so regulated that 10 l of solution was used in 4 hours. During the treatment the cotton was not allowed to come in contact with the air and the solution in the flask was kept boiling. After the caustic treatment the material was rinsed with water, the residual alkali was neutralized with 5 per cent acetic acid, and the material was then rinsed with water until neutral to methyl red.

The wool was prepared from raw wool, commercial yarns, and cloth. The visible foreign material was removed from the raw fiber by hand. The wool was then agitated in a 1-per cent solution of a neutral soap for one-half hour at 70°C., rinsed well with distilled water at the same temperature, extracted in a soxhlet extraction apparatus with alcohol for 16 hours and then with ether for 6 hours. It was then air dried, rinsed once with distilled water at 70°C. to remove residual traces of alcohol,[8] and dried in a well-ventilated oven at 60°C. for about 2 hours.

For some of the experiments, the wool and cotton yarns and cloths were used as received from the manufacturer.

III. Determination of Sizing, Finishing, and Other Nonfibrous Materials

A consideration of the variety and ever-increasing number of materials applied to textiles in the form of sizing, filling, or coating for the purpose of improving their appearance or "feel," increasing their weight, or rendering them resistant to water, organisms, fire, etc., leads to the conclusion that no practicable method is possible for the quantitative removal of all nonfibrous materials that may be present. The analyst must adapt any standard method to the material in hand. However, for the more usual wool-cotton textiles that come to the laboratory for analysis, particularly for blankets and underwear, a satisfactory standard method seems possible.

Adequate methods for the quantitative determination of materials added to the fiber in the course of manufacture or for nonfibrous natural constituents which have not been completely removed in the processing, are still to be developed. For this reason, and also because it makes little difference to the consumer of the finished article whether the nonfibrous materials are natural or added, it is logical to consider all such substances as a group for the purpose of analysis.

Specimens weighing about 10 g. each of the yarns and cloths were dried in an oven at 105° to 110°C. to constant weight. They were then treated by the method for the removal of sizing and other nonfibrous materials, dried as before, and the change in weight determined.

The scouring method involved the following steps: (1) Extracting the fibers with ethyl ether in a soxhlet apparatus for 1 hour; (2) immersion in boiling distilled water for 10 minutes; (3) immersion in 0.5-per cent solution of soduim carbonate (Na_2CO_3) at 90° to 95° C. for 30 minutes; (4) rinsing with distilled water; (5) immersion in 0.5-per cent solution of hydrochloric acid for 30 minutes; (6) rinsing in distilled water; (7) rinsing in 1-per cent solution of sodium carbonate; and (8) rinsing in distilled water.

In the malting method, the specimens were extracted with chloroform (some with carbon tetrachloride) in a soxhlet apparatus for 2 hours, allowed to dry in the air, and washed with hot water. They were then placed in a 0.5-per cent water solution of a starch-hydrolyzing enzyme at 50° C., and squeezed to remove air and insure wetting of the fibers. The solution was then heated to 70° C. and the specimens kept immersed in it at this temperature for 15 minutes.

The effects of these treatments on the weight of cotton when applied 1, 2, and 3 times in succession are shown in Figure 1 and their effects on the weight of wool shown in Figure 2. Each desizing treatment of the cotton was followed by a caustic-potash boil required by one method of analysis for the removal of wool. The total loss in weight of the specimens caused by the treatments is shown in Figure 1. It is evident that the scouring method leaves cotton cellulose more susceptible to attack in the caustic treatment necessary to remove wool than does the malting method of desizing. The malting method has much less effect on wool than the scouring method. Neither purified cotton nor purified wool loses more than a few tenths of a per cent of its weight in a single treatment. Figure 2 shows that successive malting treatments produce a small increase in weight of wool cloth that has not been subjected to the purification process. Through the increase in weight of the purified wool when subjected to the malting treatment are unimportant for ordinary analytical purposes, they may be significant for other work.

(Continued on page 185)

BOOK REVIEW

Twenty-Five Years of Chemical Engineering Progress. Sidney D. Kirkpatrick. Written by thirty-one contributors, 373 pages. D. Van Nostrand Company. 1933.

This volume was published by the American Institute of Chemical Engineers in commemoration of its Silver Anniversary. While twenty-five years is a brief interval of time, it encompasses practically the whole of the development of chemical engineering as a profession in the United States. During this twenty-five year period, chemical engineering has greatly widened its sphere of usefulness, until today, it is accepted as a definite and well founded branch of engineering. No influence has been more instrumental in bringing this situation about than the American Institute of Chemical Engineers, and it is quite fitting that this volume should have been published under its direction.

It comprises twenty-five chapters, all of which have been written by men who were authorities in the different branches of chemical engineering which have been so adequately covered, and in many instances, the chapters reflect the personal reminiscences and observations of the authors during the past quarter century. This book was prepared primarily for the membership of the Institute, but it is hoped that it will also serve a useful purpose in technical schools and libraries where a record of chemical engineering advances may formulate further study and progress.

The following comprises a list of the subjects covered, and the individual authors.

Chapter I. Chemical Engineering Research—Arthur D. Little.

Chapter II. Acids and Heavy Chemicals in Retrospect—Henry Howard.

Chapter III. Organic Chemical Industries of the United States have made most progress Since 1908—M. E. Putnam.

Chapter IV. Solvents Show Striking Advances Since 1908—Fred C. Zeisberg.

Chapter V. Twenty-five Years of Progress in Petroleum Refining—Howard W. Sheldon.

Chapter VI. Chemical Engineering Contributions to the Electrochemical Industries—W. S. Landis.

Chapter VII. Progress in the Electrometallurgical Industries—Francis C. Frary.

Chapter VIII. Advances in Pulp and Paper Manufacture, 1908-1933—G. A. Richter and W. B. VanArsdel.

Chapter IX. Coal Processing—Its Progress since 1908—Horace C. Porter.

Chapter X. The Sugar Industries—George P. Meade.

Chapter X. Continued—The Sugar Industries—R. W. Shafor.

Chapter XI—High Pressure Synthesis—Basis of New Chemical Engineering Industries—Charles O. Brown.

Chapter XII. Soap and Glycerine Industries Advance Their Technology—Martin Hill Ittner.

Chapter XIII. Chemical and Engineering Advances in the Rubber Industry—George Oenslager.

Chapter XIV. Paints, Varnishes and Lacquers Show Many Advances—Edward C. Holton.

Chapter XV. Modern Plastics—A New-Old Industry—Archie J. Weith and A. V. H. Mory.

Chapter XVI. Some Phases of Progress in Vegetable Oil Production—David Wesson.

Chapter XVII. Lime Industry Turns to Chemical Engineering—W. D. Mount.

Chapter XVIII. Glass Manufacture Changes from an Art to a Science—J. C. Hostetter and A. E. Marshall.

Chapter XIX. Fractional Distillation Assumes More Important Role Among Chemical Engineering Operations—E. H. Leslie and H. B. Coats.

Chapter XX. Progress in Evaporation in the United States in Theory and Practice—W. L. Badger.

Chapter XXI. Continuous Mechanical Separations in the Chemical Engineering Industries—John Van Nostrand Dorr.

Chapter XXII. Purification of Water for Sanitary and Industrial Uses—Sheppard T. Powell.

Chapter XXIII. Stream Pollution and Waste Disposal—Robert Spurr Weston.

Chapter XXIV. A Statistical Survey of the Chemical Engineering Industries 1908-1933—E. R. Weidlein and Lawrence W. Bass.

Chapter XXV. Chemical Engineering Education—Alfred H. White.

New York Chapter, A.I.C.

THE regular monthly meeting of the New York Chapter of the American Institute of Chemists was held at Childs' Pershing Square Restaurant, 425 Lexington Avenue, New York, on Friday evening, March 16, 1934, at 8 P. M.

A subject of interest to every chemist "Patent Problems for the Chemist" was discussed by two prominent speakers: Clair W. Fairbank, a patent lawyer, specializing in chemical patents; and Lloyd Van Doren, F.A.I.C., chemist and patent attorney. Dinner was served at 6:30 P.M. The April meeting of the Chapter will be held as a joint meeting by invitation of the North Jersey Section of the American Chemical Society at the Winfield Scott Hotel, Elizabeth, N. J., on Monday, April 9th.

Nickel Clad Steel

The Lukens Steel Co. of Coatesville, Pa., have issued a booklet describing the applications of nickel clad steel. The uses of this metal in tank construction for the textile industry are also described. Copies of the booklet are available on request.

General Releases

Alizarine Direct Blue ARA—a new acid dyeing alizarine dyestuff said to produce bright blue shades of very good fastness to light, perspiration, decatizing and hot pressing. It is further claimed that it dyes very level and that effect threads of cotton, viscose or acetate silk are not stained.

Sulphon Orange GA—an acid dyestuff which from a weak acetic acid bath is said to produce on wool a bright orange of very good fastness to washing, water and salt water. It is especially recommended by the manufacturers for the dyeing of woolen material for knitting trade.

Oxydiaminogen OBA—a new developed black which, when dyed in the usual way for direct colors and then diazotized and developed with Developer MT is said to produce a bloomy black which gives a clear white discharge with Rongalite C. It is claimed that the fastness to light is fairly good, to washing very good, and to rubbing, ironing, acid and alkali excellent.

Diazo Rubine BA—a new diazo color dyed in the usual way for direct colors and then diazotized and developed with Beta Naphtol is said to produce a full claret shade which will discharge to a very good white with Rongalite. It is claimed that the dyeings are of good fastness to washing but of only moderate fastness to light. Fastness to rubbing, ironing, alkali and acid are said to be excellent.

Copies of the above described circulars may be obtained on request to the General Dyestuff Corporation.

Discussed Corrosion Resistant Metals

Mr. H. E. Searle, development and research department, The International Nickel Company, Inc., was the guest speaker at the March 12th meeting of the North Jersey Section of the American Chemical Society when they convened that evening at 8 P. M. at the Winfield Scott Hotel, Broad Street, Elizabeth, N. J.

Mr. Searle chose for his subject "Corrosion Resistant Metals," and a substantial portion of the talk was devoted to corrosion testing procedure, in connection with which a moving picture outlining the methods used at the research laboratory of The International Nickel Company, Inc., was shown.

The physical properties and corrosion resistance of nickel and the principal nickel alloys were discussed, and some of the more important industrial applications of these metals were outlined.

U. S. Civil Service Examination

The United States Civil Service Commission announces the following named open competitive examination: Junior Scientific Aid (Textile Arts).

Applications for the position of Junior Scientific Aid (Textile Arts) in the U. S. National Museum, Smithsonian Institution, Washington, D. C., must be on file with the U. S. Civil Service Commission at Washington, D. C., not later than April 18, 1934.

The entrance salary is $1,400 a year, less a deduction of not to exceed 15 per cent as a measure of economy and a retirement deduction of 3½ per cent.

Applicants will be rated on a mental test and on their education and experience. They must show that they have been graduated from a full four-year high school course or that they have completed 14 units of high school work acceptable for college entrance. In addition, they must have had at least one year of museum experience in textile arts, or one year of experience in the use of textiles in interior decorating, or must have completed one year in a college or university of recognized standing in the same line of work.

Full information may be obtained from the Secretary of the United States Civil Service Board of Examiners at the post office or custom house in any city, or from the United States Civil Service Commission, Washington, D. C.

Open Branch Office

The Textile Finishing Machinery Co. of Providence, R. I., announces that it has opened a branch office at 919 Johnston Bldg., Charlotte, N. C. H. G. Mayer and James Cook will be the representatives and will make the new office their headquarters. Mr. Mayer, has long been the southern agent of the company and is well known throughout the trade. Mr. Cook has had long experience in engineering and mechanical departments of well-known plants specializing in the wet processing of textile fabrics.

Appoints Representative

The Technical Service Bureau, 6805 North Clark Street, Chicago, Illinois, has been appointed to serve the accounts of the Glyco Products Company, Inc., in this district, which includes the states of Illinois, Wisconsin and Northern Indiana. The personnel of the Technical Service Bureau is under the technical supervision of Clyde A. Crowley, a consulting chemist specializing in manufacturing problems and product development. This appointment makes available to the users of Glyco products in the district the combined laboratory and research facilities of Mr. Crowley's organization and the Technical Service Bureau's staff.

PROCEEDINGS OF THE
American Association of Textile Chemists and Colorists

MARCH 26, 1934

Officers of National Association

President

ROBERT E. ROSE
E. I Du Pont de Nemours & Co., Wilmington, Del.

Vice-Presidents

A. R. THOMPSON, Jr.—ALEX. MORRISON

Treasurer

WILLIAM R. MOORHOUSE
National Aniline & Chemical Co., Boston, Mass.

Secretary

HAROLD C. CHAPIN
Lowell Textile Institute, Lowell, Mass.

Councillors

JOSEPH F. X. HAROLD
DONALD H. POWERS
CARL Z. DRAVES
WILLIAM D. APPEL
HUGH CHRISTISON
WALTER M. SCOTT

President Emeritus and Chairman of the Research Committee

LOUIS A. OLNEY
Lowell Textile Institute, Lowell, Mass.

Council Representatives: Northern New England—Roland E. Derby, New York—Hans Meyer, Philadelphia—Harold B. Dohner, Midwest—Carl E. Bick

Local Sections and Their Officers

Northern New England Section
Leverett N. Putnam, Chairman, Worsted Division, Pacific Mills, Lawrence, Mass.
Clarence L. Nutting, Secretary, Arlington Mills, Lawrence, Mass.

Rhode Island Section
Heyward F. Lawton, Chairman, Borden & Remington Co., Providence, R. I.
C. Brian Wainwright, Secretary, Apponaug Co., Apponaug, R. I.

New York Section
Henry F. Herrmann, Chairman, General Dyestuff Corp., 230 Fifth Ave., New York City.
Thomas R. Harris, Secretary, Herrick & Voigt, 21 West St., New York City.

Philadelphia Section
William A. Stringfellow, Chairman, Ankokas Mills, Mount Holly, N. J.
Charles A. Seibert, Secretary, 39 Chestnut St., Salem, N. J.

Piedmont Section
George P. Feindel, Union Bleachery, Greenville, S. C.
John C. Robertson, E. I. du Pont de Nemours & Co., R. & H. Chemicals Dept., Greenville, S. C.

South Central Section
Harold Schroeder, Chairman, Dixie Mercerizing Co., Chattanooga, Tenn.
Harvie Bruce Kimbell, Secretary, Dixie Mercerizing Co., Chattanooga, Tenn.

Midwest Section
Eric F. Hempel, Chairman, National Knitting Co., 2165 South First Street, Milwaukee, Wis.
Elmer F. Smith, Secretary, American Aniline Products, Inc., 820 S. Clinton St., Chicago, Ill.

South-Eastern Section
Charles B. Ordway, Chairman, Alabama Polytechnic Institute, Auburn, Ala.
C. A. Jones, Secretary, Georgia School of Technology, Atlanta, Ga.

Lowell Textile Institute Junior Section
Raymond L. Matthews, Chairman; Charles L. Daley, Secretary.

North Carolina State College Junior Section
R. A. Gilliam, Chairman; D. B. Hardin, Secretary.

Members should notify the **Secretary** immediately of all address changes

WINTER MEETING SOUTHEASTERN SECTION

THE Southeastern Section of the American Association of Textile Chemists and Colorists held their winter meeting at the Ansley Hotel, Atlanta, Georgia, on February 10. In spite of the inclement weather, there was an attendance of twenty-nine.

The Entertainment Committee has provided a delightful program, preceding the business, which consisted of several numbers of dancing and singing.

It was suggested by Professor C. B. Ordway that letters be mailed to the mill presidents in our territory in an effort to increase the membership of the Association.

T. N. Forbes, Secretary, Cotton Manufacturers Association of Georgia, gave a most interesting talk on "The Operation of the Textile Industry under the N.R.A. Code."

W. B. Sellars, Head of the Central Laboratory, Tubize-Chatillon Corporation, Rome, Georgia, gave an excellent paper on "The Testing of Rayon."

In the discussion that followed, Professor Ordway asked whether any apparatus had been standardized for testing luster. Mr. Sellars stated that many machines had been tried, but none have proved exactly satisfactory. He said that they were working on one which they hoped would give satisfactory results.

Paul Seydel, Seydel Woolley Company, was to have read a paper on "The Chemical Composition of Raw Cotton," but was prevented from attending the meeting.

Sam Hays gave a report on the committee meeting held at Georgia Tech in the afternoon. This committee is working on mercerization, and Mr. Hays brought out some interesting points on this subject.

George P. Feindel, Chairman of the Piedmont Section, A. A. T. C. C., Arthur R. Thompson Jr., Vice Pres. of the Association, Robert W. Philip, Editor of "Cotton" Magazine, and W. J. Rooke, also connected with Cotton, were introduced to the Association.

There being no further business, the meeting adjourned.

Respectfully submitted.

C. A. JONES, *Secretary*,
Southeastern Section A. A. T. C. C.

Proceedings of the American Association of Textile Chemists and Colorists

The Testing of Rayon*

By **W. B. SELLARS**
Tubize Chatillon Corp.

THIS paper is a resumé of the methods in current use by the rayon manufacturer in testing and controlling the uniformity of his product. The subject was suggested to me by Professor Jones with the idea that the users of rayon would be interested in knowing just what standard tests are actually made from day to day, and how they are made. There are many articles appearing in the current journals discussing the variations of the methods of testing and new tests. My intention is to present nothing new, with one exception, but merely to outline the tests briefly and explain their meaning with some interesting practical applications.

Those tests which evaluate the intrinsic properties of the yarn will be discussed first; these are the inherent properties of the yarn as it is spun, not those added to it by subsequent treatment.

Denier

This is the size of the yarn; it is defined as the weight in grams of 9,000 meters of yarn at standard moisture regain. For routine control of the uniformity of the size of the yarn, a small skein of exactly 450 meters is wound on a wrap reel, such reels being manufactured especially for this purpose, under just sufficient tension to keep the threads taut, and then weighed on a special quadrant scale graduated in deniers or upon a beam balance with weights in deniers. The use of a 450 meter skein is arbitrary; knowing the above formula, we can use any size we wish and calculate the denier from the skein weight and length.

When only a very short length is available or variations in very short lengths are suspected, these can be weighed on an analytical balance; the denier of lengths as short as 10 cm. can thereby be obtained.

Tensile Strength and Elongation

This is determined in two ways: (a) By breaking a "ribbon" of 50 or 100 parallel threads in a multiple thread tester, and (b) by breaking 5-10 threads in a single thread testing machine and averaging. The latter is generally used for routine control as it does not require the winding of the threads on the wrap-reel to get the parallel band and the care to get all the threads in the jaws of the tester under the same tension. The single thread test also gives results 10% or more higher than the multiple thread test. The tenacity is expressed as the weight in grams required to break the yarn divided by the denier, or grams per denier. By this means the strength of yarns of various deniers are compared on the same basis. For instance, if a 100 denier yarn required 175 grams to break it, the tenacity would be 1.75 grams per denier, and if a 200 denier yarn required twice this, or 350 grams to break it, the tenacity as grams per denier would still be the same, that is, 17.5 grams/denier. Of course, the determination must be made at the same relative humidity each time, this humidity being the same as that at which the denier test is made. To do this, the manufacturer keeps his testing equipment in a room maintained at constant temperature and humidity throughout the year. Daily tenacity tests on many bobbins of each type and size spun are made.

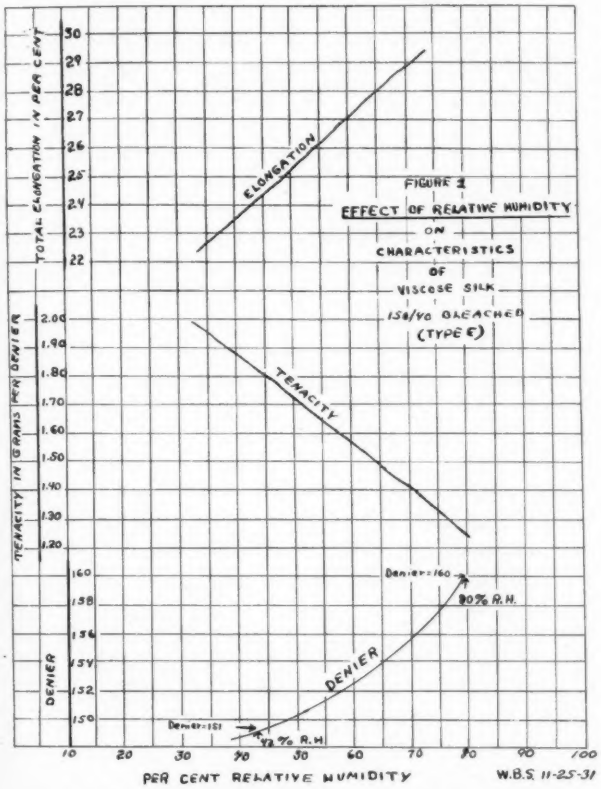
Both types of testing machines described above measure the total elongation at the same time that the tenacity is determined. This is the elongation at the moment the thread broke. It also is very dependent on the moisture in the yarn. Figure 1 shows the importance of maintaining constant humidity during testing. It will also show you one reason why the use of constant humidity during knitting and yarn processing is important; the elongation of the yarn for any given tension is different at each humidity.

Another useful attachment can be obtained on both types of the above testing machines. This attachment plots the elongation of the thread as it is stretched in the machine against the load; this gives additional valuable information in that the elongation for any load, not just the breaking load, can be obtained. This graph, called a stress-strain curve, is used in comparing the properties of yarns made by various modifications of the spinning process or the later textile processing operations.

In connection with these curves, I want to bring out the difference between elongation and elasticity of yarns, which are often confused. Elasticity is that part of the elongation of the thread which is recoverable when the

*Presented at meeting, Southeastern Section, Feb. 10th.

load is removed; in other words, the yarn goes back to its original length when the load is removed just as does rubber. There is an elastic limit, or "yield point" for all rayon yarns. With loads up to this point the thread is elastic; if the load is increased above this point, the additional elongation given the yarn is permanent.

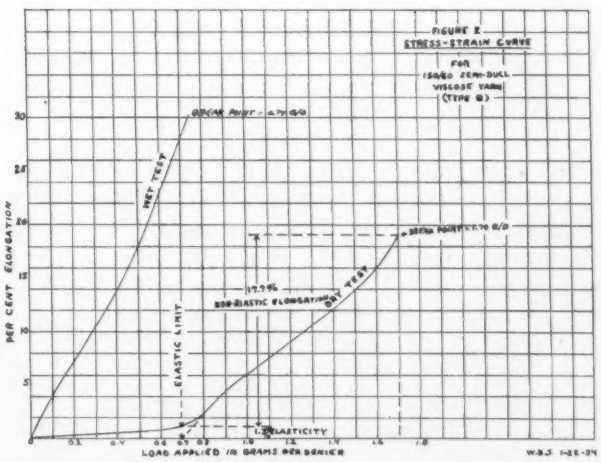


As a concrete example, suppose we have a 100 denier thread whose elastic limit is 0.7 gram per denier, elongation at this point 1%, and total elongation at the break 20%. If we place a tension of 70 grams on the thread it will stretch 1% of its length; when the 70 gram load is removed, the thread will return to its original length. Now suppose we place a load of 100 grams on the thread; it will stretch, let us say, to 10% of its original length. Upon removing the tension the elastic part of the elongation will be recovered, that is 1%, but a permanent elongation of 9% will remain in the yarn.

Figure 2 shows a typical stress-strain curve for a 150 denier, 60 filament viscose yarn, showing the elastic limit; this curve has been replotted on rectangular coordinate paper from the oblique co-ordinates in which the testing machine plotted the curve.

This subject of the effect of tension upon elongation studied by means of stress-strain curves has many interesting applications in the interpretation of the effects of tension on winding, knitting, weaving and dyeing of yarns. For instance, if the total elongation at break of the thread loaded with 100 grams in the previous example is redetermined on the testing machine its elongation will be found to be less by the amount of elongation given to it above its elastic limit, which was 9% in this case, making the new total elongation 11% instead of 20%. Carrying this principle further we can pull threads from the warp of an undyed fabric, compare their elongation at break with that of the original yarn and get an idea of how much they have been stretched in processing. The principle cannot be applied as easily to dyed fabrics because, if we take the thread given in the above example which has been elongated permanently 9%, scour and dye it and then dry without tension, it will shrink and regain a portion of the 9% elongation which was imparted to it.

It should also be remembered in interpreting such data that the loading of threads can be cumulative throughout a series of operations. For instance, suppose we are spooling the same 100 denier yarn referred to above and do it under a tension of 40 grams; this is below the elastic limit of 0.7 gram/denier of 70 grams, so the elongation is not permanent. If we now make from it a warp under a 30 gram tension without giving the thread a chance to relax, the total load is 40 plus 30 equal 70 grams and we are at the elastic limit. If we now weave the warp under a tension of 30 grams without allowing it to relax, we go above the elastic limit, having a total tension of 100 grams on the thread, and 10% elongation, 1% of which is elastic, the other 9% being permanent. When the cloth is dyed it attempts to regain most of this elongation, therefore explaining one reason for the use of the tentering frame after drying to recover lost yardage and width.



Cross-Section of Filaments

This is always tested. For routine control the simplest way of doing this is to take a small vial cork, slit it lengthwise with a razor blade, insert the thread in the slit, then cut across the thread with the razor blade, mak-

ing a section in cork about 5 mm. thick. Examination is made with an ordinary microscope at about 200x magnification.

Certain shapes of cross-section are recognized as being most desirable and all filaments should be of the same size and shape. The shape also has an effect on the luster of the yarn. Yarns of the different manufacturers can also be recognized by the shape of the cross section.

Dyeing

Dye tests, of course, are made daily to control the uniformity of dyeing. Instead of making the tests on skeins on which small differences in color are difficult to see, it has been found more desirable to knit swatches on stocking machines or circular knitting machines for jersey cloth, always comparing the dyeing with that of a standard piece of yarn knit and dyed at the same time. The small stocking swatches are best for comparing samples from different cones or packages, the larger circular knit machine for comparing differences within the same package as a much larger quantity of yarn must be knit.

Dyes which are very difficult to dye level are generally used so as to subject the yarn to the worst possible conditions. Acetate yarns are tested for cross-dyeing properties by knitting with viscose, scouring severely and dyeing. Use of knit swatches for the testing of the fugitiveness of tints on yarns has been found absolutely necessary as the making of the package, its drying and knitting sometimes sets the tint on the yarn in certain spots which would not be shown by making the test on the skein.

Shrinkage

When a shrinkage test is desired it is most accurately determined, making a skein of known length on the denier wrap-reel, lacing it, scouring, drying without tension and rewinding from a swift to the wrap-reel to measure the change in length. Measurement of shrinkage on knit or woven swatches has been found difficult to do accurately as they cannot be very easily boarded or dried under the same tension each time.

Softness

In rayon production the operators who classify the yarn are sufficiently skilled to detect minute differences in softness. This is a very important property for which no practical laboratory apparatus has been developed which will assign numerical units to softness. The difficulty is that softness as the human hand feels it is a composite of several factors such as pliability, friction of yarn against yarn and other factors.

Luster

In actual production, variations in this property are also determined by the operators. This property is also difficult to measure in numerical units but apparatus is being developed along several lines to do this and no doubt will be in use before long.

Tests for the *textile properties* of the yarn will next be discussed. Under this head I am classifying in a general way treatments made on the yarn after it has been spun.

Twist

This is checked daily and the operation of all twisters is continually checked. The test is made on the standard type of apparatus sold by manufacturers of textile testing instruments for this purpose.

Oil and Moisture Content of the Yarn

These are tested daily for the various types of yarns produced and the production of the different units. They must be maintained within close limits as the invoice weights of yarn to the customer are calculated from these results and they also determine the final denier, which is very important to the knitter. Two cones of the same yarn with the same type of oil but different amounts of this oil cannot be mixed or used interchangeably in knitting due to the difference in denier.

The usual laboratory manual methods call for extraction of the oil from the yarn in a Soxhlet apparatus and drying of a second sample in an oven for the moisture content. There is a much simpler method which one can use and eliminate the use of the expensive and easily broken Soxhlet apparatus and which requires only one sample for both oil and moisture determinations. This consists in placing the weighed sample on a filter paper in an ordinary glass funnel, washing the sample with six successive portions of ether, catching the ether solution of the oil in a distilling flask, distilling off the ether and weighing the oil. The oil-free sample left on the filter is dried and weighed in the usual manner.

Knitting Properties

These are actually tested in the mill laboratory by the use of the standard type of stocking knitting machine when the plaiting properties are to be tested, and on standard size circular knit machines where the use of the yarn for underwear goods and similar use is to be tested. Weaving tests on a small scale in a plant laboratory are not satisfactory; they are best made on a large scale in weaving mills under normal conditions.

Friction Coefficient of Yarns

This is a new term which I am introducing to you in explaining some work done in our laboratories. As you know, yarns oiled with the same percentage of various types of oil knit quite differently. In testing oils for use on our yarns we found it desirable to measure the friction of oiled yarns against a metal such as the needles of a knitting machine and assign numerical values to this friction. There is already on the market an instrument called the "Tensiometer" which is very valuable in checking the tension under which yarns are being processed on winding machines during knitting, etc.

However, we required a laboratory apparatus to be used for testing cone after cone of yarn. The photograph (Fig. 3) shows a simple device for measuring yarn friction coefficients against metal which was made from

easily available parts. The oiled yarn to be tested is run through a series of nearly frictionless guides to and under a free running guide pulley to the tension control device or "washboard" such as that used on the Universal cone winder, and then up and over a free running pulley mounted on a dynamometer or spring balance, made in the laboratory in this case to obtain greater sensitivity. The thread then runs down under another pulley to the motor driven take-up apparatus which pulls the thread through the apparatus. A constant load of a 50 gram weight is placed on the tension device. The spring balance reads the friction of the yarn in passing through the tension washboard under a constant applied load of 50 grams. The friction coefficient is the friction of the yarn read from the balance, divided by the load applied at the washboard. The uniformity of the running of the yarns is also indicated by the movement of the pointer on the scale. For a smooth running yarn the pointer will remain steady. It should be kept in mind, however, that this instrument measures friction only. The knitting properties of a yarn are determined by its softness and pliability as well as by its friction against the needles.

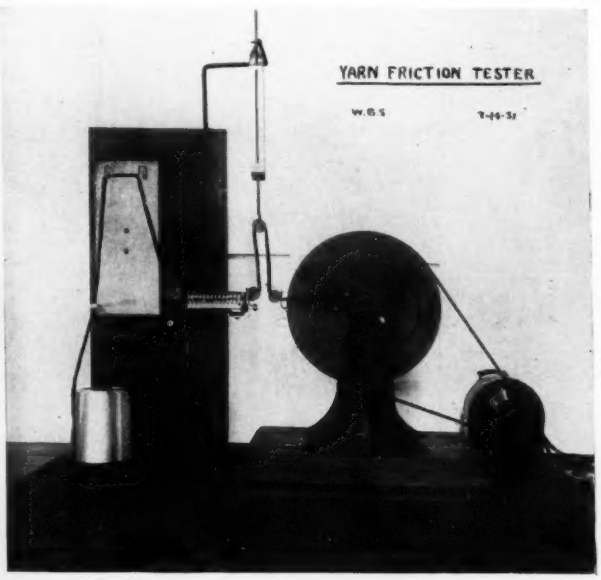


Fig. 3

I will indicate only very briefly some of our findings to date on the friction of oiled yarns against metal.

In comparing the friction coefficients of yarns with their knitting results it was found that yarns with high friction cofficients always knit with a much tighter stitch than those with low coefficients. Thus it is possible to predict in advance whether a yarn will knit with a tight or loose stitch for a given set-up of the knitting machine.

It was found that after a certain percentage of oil had been placed on the yarn the friction is not lowered further—that is, no further gain in lubrication is obtained. This point was usually at about 2% oil.

Mineral oils give lower friction coefficients, that is, better lubrication, than vegetable oils or soaps; let me add, however, that vegetable oils and soaps impart more softness to the yarn as a rule. With increasing viscosity the friction increases slightly. When oils are used which become rancid on storage or by oxidation, the friction coefficient increases markedly with time of storage.

In my opinion, use of this instrument offers very interesting possibilities for research on the oiling of yarns and should find as useful a place in the oil producer's laboratory as in the oil user's laboratory.

Hardness of Packages

The degree of hardness of cones, spools and similar packages is of great importance to the producer. The package must not be too hard or too soft and all packages must be of the same hardness. This is measured numerically by means of an instrument called the "Densitometer" and is made by an American concern.

The third part of this paper covers very briefly some of the more important tests which can be used to determine the cause of faults and defects in goods and which can be applied by anyone.

In general, the appearance of a yarn and its cleanliness can be shown by winding the yarn on a black cardboard with a spacing of about one-eighth of an inch between each turn.

Determination of denier is very important. Mixing of yarns of different deniers is quite often found to be the cause of irregularities.

The twist should be measured; mixing of yarns of different twists gives irregular appearance and dye streaks.

The mixing of yarns of different manufacturers is often easily shown by counting the number of filaments in the yarn and making a microscopic examination of the shape of the cross-section of the yarn.

Always look for knots at the beginning and end of a banded defect to determine whether a bobbin or cone of another yarn has been run in.

Shiners and dye streaks in woven goods can often be proved as due to excessive tension by making elongation determinations of threads from the defective portion of the goods in comparison of elongation of threads taken from the normal portion. Usually the elongation of threads pulled out from goods is less than that of the original yarn, therefore, comparison of the elongation of threads from the defect with that of the original yarn is misleading.

Where variation of the knitting of several cones is found determination of the oil content should be made.

When irregular dyeing is found in bands or different portions of a piece of goods the first test to be made should be a stripping and redyeing in order to show if the

defect is due to the method of dyeing, the dye used, or to the yarn.

This is only a very brief outline of tests to find the causes of defects and is not intended to be complete but suggestive of the more important tests to make.

In conclusion, I hope that I have given you an idea of the extensive number of tests which the rayon manufacturer makes on his yarn as a daily routine matter to insure its uniformity before the yarn leaves his plant and also suggested tests or ideas which may be of use to the rayon processor, dyer or textile school investigator.

JANUARY MEETING, NEW YORK SECTION

THE regular monthly meeting of the New York Section of the American Association of Textile Chemists and Colorists convened Friday evening, January 26, 1934, at the Elm Golf Club, Paterson, New Jersey, Henry F. Herrmann, Chairman of the Section, presiding.

. . . Following routine business, the technical program proceeded as follows:

Chairman Herrmann: It is my pleasure to introduce to you tonight an old friend. He is not old in years. He is sitting right alongside me. He is a very youthful gentleman. I knew he had been here several times before but I understand from him this is his fourth visit to us. As such, he is one of our most experienced speakers. I might say that the first time we called on Mr. Harry Price he spoke on a subject that seemed a little remote to us. We were all a bit skeptical about acetate fabrics. There was something a little mysterious about them and we were all very much in doubt as to whether they would ever amount to anything.

One may safely say that the next time Mr. Price came, the acetate fabrics had developed quite a little more importance and so today I think it only fair to say to Mr. Price that this rather large gathering is an acknowledgment of the fact that the acetate fabrics really absorb the major interest of those of us interested in operations in the Paterson district.

I take great pleasure in again presenting to you Mr. Harry Price of the Celanese Corporation who will speak on the "Preparation, Dyeing, and Finishing of Celanese Fabrics."

Mr. Price! (Applause.)

Preparation, Dyeing and Finishing of

Celanese Fabrics*

By **HARRY PRICE**
Celanese Corporation of America

WHEN the Chairman of your Program Committee came to me about three weeks ago and asked if I would talk about Celanese at this meeting, I was a bit dubious about accepting the invitation, not because I have any particular objection to talking nor because I did not appreciate the honor of being asked, but because, as Mr. Herrmann has said, I had addressed this Section on three previous occasions and I have been in fairly close contact with most of the dyers in the metropolitan area during the past year, and I felt that I had about talked myself out. However, at his insistence, I accepted his kind invitation to come here and talk about the dyeing of Celanese fabrics.

I learned that the last talk you had here on the subject of Celanese, or so-called "acetate," was based largely on yarn, so I agreed to talk on the dyeing of fabrics. I must admit that that decision was largely influenced by the fact that I know considerably less about the manufacture of the yarns than I do about the dyeing of Celanese fabrics.

During the past twelve months there has been a great deal of talk, a certain amount of grief, a certain amount of worry, and a great deal of work in connection with the processing of Celanese fabrics, or other cellulose acetate fabrics, but as a result something like two hundred million yards of fabrics either made of or containing Celanese or other cellulose acetate yarns have been dyed and finished.

*Presented at meeting, New York Section, January 26th.

It would be ridiculous for me or, for that matter, for any other living individual to stand here before you and pose as an absolute authority on the dyeing and finishing of Celanese fabrics. In spite of the fact that there has been a tremendous yardage made, dyed, and finished, all of us still have a great deal to learn.

Mr. Herrmann spoke about my being here several years ago. I remember it very well. That was about eight years ago. My experience with the Celanese Corporation at that time was limited to a very few weeks and I probably knew as little about Celanese as any of you that were here, and I want to tell you that I stood here in fear and trembling that evening. But in the eight years since then the greater part of my time has been devoted to the dyeing of Celanese fabrics and I feel that I have learned a great deal. I am sure that you have learned a great deal. Many of you have probably learned a great deal more than I have about it. And I will frankly say that some statements that I may make during the course of this short talk are debatable.

So-called experts on the dyeing and finishing of Celanese fabrics disagree on many points. I know of no two plants in the metropolitan area or any other part of the country for that matter who are doing everything identically the same. In our own plants we have some differences of opinion and methods, so there is no reason why others shouldn't disagree, and it is quite possible that in many things others come just as near to being right as our own people do.

Handling Operations

If I may borrow a quite common phrase—in fact I have heard it mentioned once before this evening—fabrics, looking at them from the dyer's point of view, may be divided into two classes: those dyed in winches and those dyed in jigs. We might possibly add a third class: those that are dyed in boil-off boxes. Each of those three, of course, is divided into sub-classes.

Jig-dyed fabrics take in satins, twills, taffetas, etc. Winch-dyed fabrics include the failles, Celanese and silk crepes, Celanese and rayon crepes, all the knitted fabrics, etc.

If we can speak of a third class, the boil-off class, we would include there the voiles and ninons.

I mention that class because in some plants the voiles and ninons are dyed in boil-off boxes. In other plants I know they are dyed on winches and in still other plants they are dyed on jigs. Each method has its own advantages and merits and good results are obtained in all three ways.

I think, however, the class of fabric which the majority of the dyers are interested in today is the winch-dyed fabrics or, to be more specific, the crepes, whether the crepes be Celanese and silk or Celanese and rayon. I have found more differences in various plants dyeing that particular type of fabric than in any other.

I can also say that the different finishing plants can find more things to do with a crepe fabric to add to their costs than they can with any other fabric.

If we think of the individual operations, you have first the preparation, the boil-off, then the dyeing, and then the finishing. The boil-off is very simple and yet it is probably the most important feature of the processing of this type of fabric. If your fabric is not properly prepared it is not going to absorb the dyestuff evenly and you will probably get break marks (or string marks if you have strung it for boil-off); you will not get the proper crepe, and any number of other things can happen to it.

We have found that the best method of handling this fabric is to prepare it in hank form, suspend it on bent rods so that it is completely submerged in the boil-off tank, in a solution containing from ten to twenty grams per liter of soap, starting at a temperature of eighty degrees centigrade, bringing it up to ninety-eight degrees centigrade, and maintaining that temperature for two and a half to three hours.

There must of necessity be some variation to that. You can't make it a hard and fast rule. You have different constructions. If you have a fabric which crepes very rapidly, you have to start it at a lower temperature and bring it up more slowly to that temperature, or, if you have a fabric which contains Celanese of natural luster and you want to maintain that luster, you must maintain your temperature at about eighty degrees centigrade, and it will take you a longer time to boil-off. But fully ninety per cent of the crepes today demand a dull finish. Therefore, the temperature is not of great importance. By that I mean you can go up to ninety-eight degrees and maintain that temperature.

I have found that in a number of plants it is felt that it is necessary to give Celanese and rayon, or Celanese and silk crepes additional treatment before the boil-off. The majority of the plants today are embossing fabric before boil-off. That is one of the debatable questions which I mentioned before.

Embossing

In our own plants we do no embossing of greige goods and we see no need of doing any and I think I can honestly say that we turn out just as good dyeing as anyone of your plants in Paterson or anywhere else. We must, because we have a standard to set.

I have sent out fabrics to four or five different finishing plants with a request that they be embossed. I have taken a piece of greige goods of exactly the same construction and consolidated these various pieces which have been sent out to plants to be embossed, and had

them dyed and finished together as one piece, and I found that there was just as much crepeing in the piece which was not embossed as there was in those pieces which were embossed.

You will get an occasional piece possibly where embossing is an advantage. Embossing will certainly break up creases that are in the piece, but as far as crepeing is concerned I fail to see where it does one bit of good and its adds approximately one-half cent a yard to your cost.

I think that the converting trade in New York today feels that every piece of crepe fabric they get is embossed and I think that this idea of embossing has been to a certain extent sales talk. If any one of your finishing solicitors goes in to a converter, one of the first questions he is asked is, "Do you emboss the fabrics?"

They invariably say, "Yes," and I know and you know that every piece of fabric is not embossed.

I don't think there is a finishing plant in the metropolitan area, that is consistently dyeing an appreciable quantity of Celanese, that has embossing machines enough to take care of the crepe fabrics that they can put through their plant. I may be wrong.

Subsequent Operations

The fabric is taken from the boil-off box and transferred to the winch. Of course, the number of pieces that you can put on a winch depends entirely on the size of the winch and on the quality or construction of the fabric which you are running. We figure on getting one batch per day out of a winch, except in light shades. We can get two batches per day in light shades.

I have had many dyers tell me that they get two batches a day, per machine of any shade; it doesn't make any difference whether it is white or a medium shade or a navy blue or brown or black, they say they get two batches a day. If they get two batches a day I wish they would come around and tell us how they do it because we can't do it. But in getting one batch a day we do believe in getting advantage, full advantage, of every ounce of dyestuff that is in that dye box, and dyestuff is just as expensive as labor. Dyestuff cost on the winch-dyed fabrics represents approximately one-third of the total cost of dyeing and finishing the fabric. At least, that has been our experience.

The fabric is taken off the winch and the next operation is extraction. There again, depending on construction, you have the choice of extracting on the vacuum extractor or in a whizzer. If the extraction is done in a whizzer, you must make sure that you do not leave it in too long. If you over-extract you will have hard creases in your fabric which you will not be able to get out in the finishing.

From the extractor, the fabric goes to the finishing-room, and there again you find all sorts of ideas and opinions as to just what should be done. I have found that in some places the fabric is run through a net-dryer over a compensator and through a loop-dryer. In other cases it is run through just a net-dryer. In other places it is not run through a dryer at all. Between our two plants I don't think that we run two per cent of our fabric through either a net-dryer or a loop-dryer. It is run over the tentering-frame. Any softening that is necessary is then given it and it is run over the tenternig-frame again and brought out to width.

You may well argue about the necessity of a net-dryer, but remember this: you get every bit of crepeing that you are going to get in the boil-off and unless you have tension on the fabric from there on your net-dryer or loop-dryer is not going to give you any more because you have the maximum to start with. If you have stretched the goods out then I will admit the net-dryer or loop-dryer is desirable.

It costs you probably a half cent a yard to run it through the net-dryer; through the net and loop-dryer probably three-quarters of a cent a yard. That three-quarters of a cent might just as well be saved. Some fabrics may need a cool calendering. Others may need running over the button-breaker, but very few crepes require it.

Costs

Just a word about costs. I have heard all sorts of stories about costs of dyestuffs, costs of labor, costs of handling, etc. I have just had the opportunity in the last week of going through a plant that has handled many millions of yards of both Celanese and silk and Celanese and rayon crepes. Their average for the year has been well over a million yards a month. In only two months out of the last twelve has their cost for dyestuff reached two and a half cents per yard, and in three months out of the last twelve their dyestuff cost was below three-quarters of a cent a yard.

I have yet to find a dyehouse in this area that will admit that their dyestuff costs average less than four cents a yard. Now, where is it going? Down the sewer. If we can do it for that price—and our dyehouse in Cumberland sticks pretty close to that cost—you can.

I am not going to talk about dyestuffs. There are too many dyestuff people here for me to get embroiled in anything of that sort (Laughter). But let me repeat that your dyestuff cost represents approximately thirty per cent of your total cost in handling this type of fabric, and practically all of you pay too little attention to the dyestuffs that you are using, and I don't mind saying that I think ninety per cent of you pay almost no attention to the dyestuffs that you are using.

You have today eight or ten different ranges of dyestuffs to select from and you probably buy all or most of

your dyes from one of those ranges. It is a good thing for the representative of that particular range of dyestuffs. But there are dyestuffs in one range which are better than the corresponding dyestuffs in any other range, and there are dyestuffs in other ranges that are better, and so no, and I certainly think that a little attention paid to that will save you money.

If a plant that is handling twenty-five million yards of fabric a year can save only a half cent a yard—and that is not impossible by any means—that means one hundred and twenty-five thousand dollars a year, and knowing that there are none of you dyers who will say that your dyestuff cost is less than four cents, and knowing that our dyestuff cost is less than two and a half cents, over a year, there is a difference of a cent and a half per yard of fabric.

Many people seem to think, I don't know why, that the most expensive shade to dye is black. We don't find it so. There are shades of navy, dark brown and dark green which are more expensive to dye than black. There are some shades which we dye that cost as much as three and four cents a yard more than black does. But I have yet to hear the dyer who will say that anything but black is the most expensive shade that he dyes. Recently there has been a new scale of dyeing and finishing prices submitted that emphasizes that fallacy. Blacks are set at a cent or two higher than any other color in the range. There may be other reasons than cost, I don't know.

Jig-Dyed Fabrics

We might spend a minute on jig-dyed fabrics which take in satins, taffetas, twills, etc., mostly taffetas today. Of course, some of these fabrics have a certain amount of oil in them and sizing and often tinting when they reach the finisher, but today at least ninety per cent of that sizing and tinting is done with sizes which are very readily removed. You will occasionally find a batch which gives you difficulty but on the whole it is only necessary to give the fabric two ends in warm water on the jig, and then your dye bath and scouring bath may be made up without dropping the bath.

When your shade is reached, the fabric should be washed thoroughly, giving warm and cold rinses, not going suddenly to a cold rinse, then either extracted on the horizontal extractor or a vacuum extractor, and then tentered.

In the tentering-frame the temperature should be maintained at from one hundred eighty to two hundred forty. Just where the correct point is I hesitate to say. I have seen excellent work done at both temperatures and, personally, I am inclined to believe that the temperature at which the fabric is dried has very little bearing on the hand. I don't suppose there is one man here who will agree with me but having seen them tentered at one hundred eighty and also having seen the same fabric tentered at two hundred forty with the same results, I am inclined to feel that that is so.

After tentering you again have the matter of running over the button-breaker or the calender. There are very few all-Celanese fabrics which require any softening or stiffening agent.

The most common error with jig-dyed fabrics seems to be in putting finishing material into the fabric when it is not necessary.

Fabrics which are dyed in the boil-off are limited to voile and ninon and, as I say, many plants are now handling those two fabrics either on the jig or on the winch. With the new constant speed jigs which are now on the market there is no reason at all why even the flimsiest of fabrics should not be handled in that way. We have for a long while in our own plant handled both the voile and the ninon in the boil-off. We found that it was more economical to boil-off and then dye in the boil-off rather than transfer from the boil-off box to the winch. After taking out of the boil-off tank that fabric is merely tentered and run over the button-breaker.

Now, gentlemen, I have just tried to hit the high spots. I know that the most interesting part of this discussion will be in an open forum. As I said before, I have talked so much on this subject that I feel that everyone else is probably bored with it, but I will be glad to answer any questions that any of you ask if it is possible for me to answer them. I only ask that you limit your questions to the handling of the fabric in the dyehouse rather than questions as to the chemical construction of the yarn or anything of that sort.

Thank you. (Applause.)

Discussion

Chairman Herrmann: Before proceeding with the open discussion, I would like to check just one thing and that is whether there are any newspapermen in this room. It was more or less agreed among us that we were going to have a little family council here tonight during which we would be free to talk just as though we were among ourselves, without any idea that we were speaking for the pubilc press. Being just among ourselves, an earnest group of chemists, dyers, etc., etc., I think we can well accept Mr. Price's invitation to join in a more or less general discussion. Mr. Price has given you many points that may possibly suggest a few questions. If so, let us have them. The floor is open to anyone who has any comments or questions.

Mr. Nazarro: Mr. Chairman, I would like to have Mr. Price's views on continuous boil-off of acetates.

Mr. Price: We have felt that a Celanese crepe fabric requires considerable boil-off before it is ready for dyeing. In order to get the best possible penetration and level dyeing you must thoroughly wet out the yarn and

up to the present time we have not found a continuous boil-off practical. That does not mean that it is impossible. I do know that it is being done in some plants and that fairly satisfactory results are being obtained. But we are not doing it in our own plants.

Mr. Mostick: One hundred fifty denier acetates, forty-four in the length, that haven't been embossed, and after being soaked for two hours and boiled for two hours at ninety-eight degrees centigrade, do not come in any more than to thirty-nine and a half in the boil-off. How can you get more shrinkage?

Mr. Price: You are not going to get more shrinkage than that in Celanese yarn.

Mr. Mostick: Suppose you have that piece tested out and you find that it is only forty-six to forty-seven turns where it should be fifty to fifty-five, would that be the fault of the dyer or the fault of the mill who constructed the goods?

Mr. Price: The dyer has nothing to do with the number of turns.

Mr. Mostick: But still in all he is responsible for the goods when he puts it in process. It is supposed to be fifty to fifty-five turns.

Mr. Price: I understood you to say that you had a fabric made from one hundred and fifty denier acetate.

Mr. Mostick: That is right.

Mr. Price: That you wanted to bring it to thirty-nine inches from maybe forty-four or forty-six. You are not going to do that if it is acetate. The shrinkage is in the filling, in the rayon or silk yarn, not in the acetate.

Mr. Mostick: But it is acetate and rayon. For instance, the same construction from other mills can be brought into thirty-three, thirty-four, without any trouble. You run across this yarn and you can't get any shrinkage, or this piece of goods, rather, although it is of the same construction as what you have been running.

Mr. Price: Variation in twist is certainly going to affect the amount of shrinkage you get.

If your twist varies that much, it is certainly the fault of the grey goods mill, or the throwster.

Mr. Mostick: It would be the fault of the grey goods, but the dyer would naturally be condemned for not processing the goods properly.

Mr. Price: I can't help that.

Mr. Barber: I think I can help out the gentleman who asked the last question by saying that no shrinkage takes place except from the twist, that is in the filling yarn, in the width, and that any throwster who has a hundred and fifty denier yarn varying more than three turns up or down doesn't know his business and the dyer is not responsible for his errors.

Mr. Schmidt: I should like to know if you use any finishing compounds in the finishing of the Celanese or if you just dye it and say it is finished?

Mr. Price: That depends entirely on the requirements as to hand, etc. As I mentioned before, very seldom in the jig-dyed fabrics such as the taffetas is any finishing ingredient required. However, finishing oils are often required in the crepes. It is impossible to specify any one finishing oil, there are so many of them that are suitable.

Mr. Leopold: Is there any particular temperature, say, one hundred and twenty or one hundred and ninety, that makes the finishing absorb better?

Mr. Price: A temperature of around one hundred fifty degrees Fahrenheit is quite all right.

Mr. Eisenmann: Mr. Price claims that his dyeing costs from two and half to two and three-quarter cents whereas the cost of the average dyer is around three to four cents. Will he tell us how he dyes at the lower cost, whether he dyes it by formula, or whether he dyes it to match shades, or does he have his formulas already built up before his goods reach the dyer?

Mr. Price: We undoubtedly have as many shades to dye as any commercial dyehouse. We run a considerable number of different constructions and we run anywhere from forty to eighty shades in each construction. Whether we dye the same shade once or fifty times is more or less beside the point. If the shade is dyed a second time, we have the formula to work with. The first time we have to build up the shade, naturally, but on the second dyeing or third dyeing, and from there on, we have the formulas to work with, of course.

Our dyehouse does not have the advantage that the outside dyehouse has in selecting dyestuffs because it is restricted to the use of a certain range of dyestuffs, except where it can't get a particular shade in that range. In other words, we can't go to another range of dyestuffs because we can buy a certain dyestuff cheaper. The outside dyehouse can do that.

Mr. Nazarro: Mr. Price, is there any special chemical that you people use as a mordant, to have it draw quicker?

Mr. Price: No. In our dye bath we use nothing except soap and Celascour.

Chairman Herrmann: If I may be permitted a comment on the question concerning the varying costs of dyeing a given shade I would just like to say that in my experience the most costly thing—and it is most wasteful of the dyestuff—is the building up of a shade in a kettle which means adding possibly five or ten times the necessary amount of color in order to effect a certain color change rapidly; taking samples at five or ten-minute intervals means putting in five, ten or twenty times as much dyestuff as may be required to produce a certain effect. As soon as the shade is reached, the plug is pulled and maybe a valuable amount of dyestuff is allowed to run away.

Possibly the experience of Mr. Price's organization has shown that it is better to build slowly from the ground up and to work towards an exhausted liquor or as nearly exhausted as expediency permits, which may or may not

be an argument for dyestuffs that exhaust completely, I don't know.

Dr. Cadgene: Has the fact that the Celanese Corporation has a large investment in certain dyestuff manufacturers anything to do with the cost? (Laughter.)

Mr. Price: No, sir. I can only repeat that, if anything, it is a disadvantage to our dyehouse.

Dr. Cadgene: The dyestuffs are not so good? (Laughter.)

Mr. Price: That is not the reason. Those dyestuffs are sold to the trade at either the same or a lower cost than they cost the Celanese Corporation. The Celanese Corporation's dyehouse is charged all the way through with the cost, i.e., the actual cost of the dyestuffs. The outside dyer can buy those particular dyestuffs cheaper than our dyehouse in Cumberland can.

Mr. Barber: Mr. Price, I am not a dyer, but the statements you have made have raised a question in my mind. You say that it costs you two and a half cents and that over a period of three months it only costs you three-quarters of a cent. There is a wide difference there. Where did it go?

Mr. Price: Well, you have a very wide difference between your winter shades and summer shades. Don't forget that.

Mr. Barber: Is it a difference of a cent and three-quarters?

Mr. Price: Taking the two extremes. yes.

Chairman Herrmann: I should like to ask Mr. Price a question.

During this fall season of very high colors—I believe they were know as the Chinese shades of red, green and blue—would your average have been your lower figure or your medium figure, or would it have been a higher figure? They were fairly intense shades and if a dyehouse had happened to get a majority of full colors, and only very few light colors, their average might have been somewhat over your figure.

Mr. Price: Our average dyestuff cost during August, September, October and November, four months when heavy shades predominate, was about one and a half cents per yard.

Chariman Herrmann: That must have included a tremendous yardage of very pale shades—underwear shades.

Mr. Price: No, sir, not a tremendous yardage by any means.

Chairman Herrmann: When I say "tremendous," I mean possibly seventy-five per cent.

Mr. Price: There are few underwear shades amongst the crepes during those four months. I say that those are four months when the heavy shades predominate, and I am thinking particularly of the crepe dress fabrics. A small proportion might have been in light underwear crepes but that cost was the average dyestuff cost per yard of fabric for the four months, covering the entire range of dyeings of various crepe constructions, practically all of which were Celanese and silk.

I had occasion only a few weeks ago to check over a range of forty-five shades on a fabric that weighed twenty-seven pounds to the hundred yards, Celanese-silk crepe. Of the forty-five shades, the most expensive color was seven and three-quarters cents per yard, for dyestuff cost alone. I don't remember the exact number but for something like twenty of those shades the dyestuff cost was under a half cent. There were about twelve where the dyestuff cost was above three cents. The balance was, of course, between a half cent and three cents per yard.

You might get an occasional shade where your dyestuff cost is as high or higher than seven cents per yard, but when the large portion of the shades come under a cent a yard it is going to average up to a pretty low figure.

Mr. Kivelson: I would like to ask Mr. Price the reason that navy, black and brown do not crepe up as well as the light shades, leaving the cost aside.

Mr. Price: Well, there is no reason in the world why they shouldn't crepe as well as light shades. All of the creping is done before the dyeing. If you are dyeing navy, black and brown, possibly you are overtreating the fabric and under tension pulling it out. But the color has absolutely nothing to do with the crepeing. The crepeing is all done before you start dyeing.

Mr. Leibiger: I would like to ask if the heat in the boil-off or any heat, even at the finishing, has any effect on the shrinkage of the acetate or of the viscose. I am talking about two-fiber goods. Mr. Price stated that the shrinkage is done in the boil-off and if the shrinkage didn't happen in the boil-off you would never get it.

Is the shrinkage of the fiber only a matter of taking out material, out of the fiber, or is it also a question of heat?

Mr. Price: I say that you are going to get, or you should get, all the shrinkage possible in the boil-off. It is quite possible to stretch your fabric from there on. Then, running it through a net-dryer or a loop-dryer and drying it will contract it again, but once you have gained your maximum shrinkage or crepeing in the boil-off, drying at a high temperature is not going to give you more crepeing.

Mr. Barber: Mr. Price, may I ask one more question?

At your plant do you have any difficulty due to your finished product having crease breaks, and where do they come from?

Mr. Price: We have pretty well eliminated that, Mr. Barber. At one time when we were boiling-off and delustering the fabric through stringing it, we did have some trouble, but hanking the fabric, rather than stringing it, gives us no creases. Unless there are actual break marks in the raw goods and filaments of the yarn are actually broken, and those of course, cannot be eliminated, there is no reason why you should get any more through your processing.

Mr. Barber: But suppose the goods get dry, either after boil-off—

Mr. Price: We don't let them get dry. We follow right through. It goes from the boil-off to the dyehouse, to the finishing directly, and it never gets thoroughly dry until it is actually finished.

Mr. Barber: Then you would say that those breaks in the finished fabric could come either from drying between processes—

Mr. Price: It is quite possible. It depends on where the fabric is and how it lies around. If it is not taken care of, you are quite likely to get them.

Mr. Clark: I should like to make a statement for the record to prevent dyehouse owners getting the impression that their dyers are wasting a great deal of dyestuff, as these figures might indicate. They might very well gather that impression if they were to see only those remarks and not take into account the other factors. It seems some of the other factors, therefore, ought to be put into the record, namely, that many of the small dye shops in this neighborhood have much less machinery than they require for the amount of production they want to turn out, and a great deal of pressure is put on the dyers for production, which perhaps doesn't occur so much in the Celanese plants. And while it isn't strictly the correct thing to do, yet these dyers are forced perhaps to use more dyestuff than is theoretically necessary in order to get production.

I am putting these facts into the record, as I say, so that a dyehouse owner won't read the remarks that have been made here this evening and immediately say, "Well, my dyer is throwing two cents worth of dyestuff down the sewer."

Chairman Herrmann: Mr. Kivelson, you asked a question before and I would like to inquire whether you had in mind a special process for dyeing these blacks, navies and browns, whether they were diazotized or direct dyeings?

Mr. Kivelson: Developed.

Chairman Herrmann: It was wondering whether Mr. Price would like to comment on the added length of time required for a developed process, and whether that might possibly take the crepe out of the material?

Mr. Price: That is possible. A diazotized and developed fabric, instead of being in the dye bath anywhere from three to five hours, is quite likely to be there eight hours, ten hours and even as long as twelve hours. When a fabric has been over processed it would probably be advisable if not necessary to put through a net-dryer to restore the crepeing.

Mr. Kivelson: Even so, Mr. Price, it doesn't help much. We use a net-dryer and quite a few dryers. The trouble seems to prevail in black and navy and brown. They don't have the crepe that the other colors do.

Mr. Price: Well, as a rule, the complaint is just the reverse; that it is more difficult to get it out to width, once you have your crepeing, than it is to get down to the width that you require or desire.

Chairman Herrmann: Gentlemen, the hour is getting late and we are far from home. I don't want to cut this discussion short but we must speed it up.

Mr. Kennedy would like to ask a question.

Mr. Kennedy: Mr. Price made some very interesting remarks about dyestuff costs. During the past month most of the dyers here in Paterson running on viscose and acetate piece goods creped have been running on navies. What is his experience as to dyestuff cost on navies? I refer to full shades.

Mr. Price: I had a piece of Celanese and silk fabric submitted only this morning, dyed Marine Blue. That is a fairly deep shade. It cost eight cents a yard for dyestuff and chemicals.

Mr. Remlein: Can you tell us what a Seal Brown shade would cost to dye?

Mr. Price: No, I am sorry. I can't remember the costs of all shades.

Mr. Remlein: Could you dye it for less than nine cents a yard?

Mr. Price: I don't believe it would cost that much.

Chairman Herrmann: Are there any further comments or questions? I am almost ready to ask for a motion to adjourn but I don't want to cut off the discussion if anyone has any further questions to ask.

Mr. Kipnes: What is your average cost on chemicals and other finishing materials on acetates?

Mr. Price: Our chemical cost—including as chemicals all of the dyeing assistants—is probably high in proportion to the dyeing cost. It is slightly less than a cent a yard.

Mr. Wood: Just one more question, if I might ask it, and that is do you employ standing baths for any of these colors you dye so economically?

Mr. Price: No, sir, we do not employ a standing bath on any color.

Chairman Herrmann: I think a motion is in order to thank Mr. Price for coming here tonight.

Mr. Wood: I move a hearty vote of thanks to Mr. Price and I also move that we adjourn.

Chairman Herrmann: I suggest that this be a standing vote of thanks to Mr. Price.

. . . A standing vote of thanks was extended to Mr. Price. The meeting thereupon adjourned at nine-fifty o'clock . . .

Proceedings of the American Association of Textile Chemists and Colorists

A Fundamental Study of

Printing Pastes

Preliminary Report (Project 6-33)

By SIVERT N. GLARUM
Research Associate, A. A. T. C. C.

EVERY individual concerned with the preparation of colors for textile printing possesses a certain amount of knowledge regarding the preparation and usage of the various materials which must be mixed with the dyestuff in order to produce a color that is suitable for printing. This knowledge is chiefly the result of personal experience and isolated observations. The result is that the methods and materials used today are the product of trial and error methods and any problems arising must be solved by the same methods. It is the initial purpose of this investigation to attempt to determine and measure those physical properties of the prepared vat printing colors that affect their printing qualities and to evaluate the effect of each ingredient on these properties.

This constitutes the first published report upon a research project entitled "A Fundamental Study of Printing Pastes," which is being carried out by the Research Committee of the A. A. T. C. C., the Sub-Committee on Textile Printing Pastes* acting as advisors.

Wm. H. Cady, Chairman of the Sub-Committee, has been actively engaged in the supervision of this work, and acknowledgment is hereby made of the valuable service he has rendered. The experimental work has been largely done in the laboratories of Brown University, and the Research Committee wishes to express its thanks for the valuable assistance thus rendered.

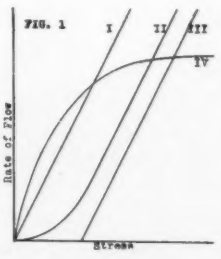
This research project has been made possible through an allocation from the Textile Foundation.

L. A. O.

Consistency

Thickness, stiffness, "body," "length," viscosity, and consistency are all terms that are commonly used to describe properties of pastes relating to their flow when they are poured or stirred. No one of them alone is sufficient to describe adequately the flowing properties of any paste. None of these terms as used has an exact definition but each depends entirely upon the individual observer. The most common method of comparing the properties of different samples is the "feel" when they are stirred and the manner in which they run off the stirrer. This method necessitates examining all the samples to be compared at one time which is often difficult if not impossible. Such a test may give an idea of the relative properties if all the samples are of similar constitution but for different types of pastes there is no assurance that the results are even relative. Knecht and Fothergill[1] state that, "It is impossible for anyone by a mere inspection to estimate with any degree of certainty the relative printing qualities of two colours are thickened with totally different materials. Gum thickenings rarely or never appear to be as thick as starch, flour, or tragacanth pastes; but thickness considered merely as stiffness, is not the only desirable quality in a printing colour." This applies to the materials from which the color is made as well as to the prepared color. It would seem, therefore, that the first step in this investigation should be a study of the flowing properties of the various pastes used as shown by viscometric data.

Williamson[2, 3] has recently classified the different types of materials as viscose liquids, pseudoplastic dispersions, plastic dispersions, and dispersions showing inverted plasticity according to the type of flow-stress relation which they exhibit. Figure 1 illustrates the differences between these types of flow. Curve I, a straight line passing through the origin, is the shear-stress curve for an ideal liquid. Curve III, a straight line intercepting the stress axis is the shear-stress curve for an ideal plastic. In this case the flow does not commence until a certain stress, represented by the intercept with the stress axis is exceeded. Bingham and Green[4] have called this stress the "yield value" of the material and the slope of the line determines the mobility. Bingham[5] has also



*Wm. H. Cady, Chairman; Arthur E. Hirst, Alfred L. Lustig, Morell Mackenzie, Louis A. Olney, Robert E. Rose.

pointed out that certain materials do not flow in accordance with the laws of ideal fluids or of ideal plastics. Curve II is the shear-stress curve for a material of this type which Williamson has termed pseudoplastic. At very high rates of shear the curve approximates a straight line but at low rates of shear it curves toward the origin. Curve IV is the shear-stress curve for a material showing inverted plasticity which is encountered only in very special cases.

The substances most commonly used for thickeners in preparing the colors are the starches, dextrines, British gums, gum tragacanth, and the natural gums. Numerous tests have been proposed for testing starch pastes. MacNider[6] has reviewed a number of these tests, none of which are satisfactory. These early methods do not recognize the fact that these pastes can not be treated as true liquids and therefore no single value can be found to describe their consistency. Herschel and Bergquist[7] have studied the plastic properties of starches, dextrines, and British gums by means of the Bingham-Green plastometer[4] and their work has been continued by Porst and Moskowitz.[8, 9] Caesar[10, 11] has recently developed a method of studying the consistency changes in starch pastes during cooking. Very little work has been done on measurements of the physical properties of natural gums.

The prepared vat printing colors appear to have properties quite analogous to paint. Rogers and Sabin[12] made an early attempt to standardize paint using a Stormer viscometer and treating it as a viscous liquid. Bingham and Green[4] studied the flow of paint through capillaries and showed that paint is a plastic material and not a viscous liquid. They evaluated the "yield value" and mobility as the characteristics determining the consistency. The factors affecting these properties have been studied by numerous workers[13, 14, 15, 16, 17] using the same method. Green and Haslam[18, 19] have pointed out that the "yield value" obtained by the above method differs greatly from the actual yield value of a paint and have developed a microplastometer which permits direct observation of the minimum pressure required to start flow through a capillary. Williamson and his co-workers[20] have shown that paints belong to the class of materials that he terms pseudoplastic. They used a modified Stormer viscometer for obtaining plasticity data. McMillen[21] has recently attempted to evaluate the effect of thixotropic changes upon the consistency of paints by means of a modified Kampf viscometer and to relate these values to the leveling characteristics.

This investigation to date has been concerned principally with a study of the physical properties of prepared colors as shown by various viscometric methods and an attempt to correlate these properties with printing qualities. A preliminary study of the flow-stress relations of the various materials used for thickeners has also been made.

Properties of the Prepared Colors

One frequently hears mentioned the expression "ideal color" or "perfect color" implying at least that there should be a color of such properties that it would yield a good print no matter how it might be applied. Before making any attempt to determine the physical properties of a prepared color which have an influence on the quality of the print, it is necessary to note the innumerable other factors which must be taken into consideration. The most prominent of these are: the type of pattern, the depth of engraving, the speed of the machine, the temperature and pressure of the rollers, the bevel of the doctor edge, the weight and pressure of the doctor, and the weave of the cloth and its pre-treatment. At best we may hope only to establish certain limits for the physical properties of a color which will give a satisfactory result under specified conditions.

Since we had no means of determining the printing qualities of a prepared color other than by observing the result attained in actual practice, all samples of color were obtained directly from the print room of the plant where they were actually in use. They were broadly classed according to the type of pattern on which they were used and whenever possible samples of the printed cloth were obtained. In later cases series of colors which were used on the same rollers and the same cloth were obtained in order to decrease the variables as much as possible.

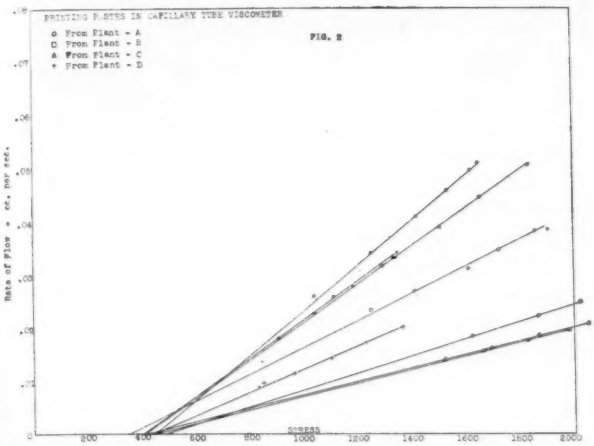
Measurements with the Capillary Tube Viscometer

This method, described by Bingham[22] consists of measuring the rate of flow of the material through a capillary of known dimensions at varying pressures. The data are treated graphically by plotting the rate of flow in cubic centimeters per second against the shearing stress. At sufficiently high rates of shear the points lie on a straight line which, when extended, intercepts the stress axis. The value of the stress at this intercept determines the "yield value" and the slope of the line determines the mobility.

The value of the shearing stress, F, is given by

$$F = \frac{PR}{2l}$$

P is the pressure in dynes per square centimeter, R is the radius of the capillary in centimeters, and l is the length of the capillary in centimeters. The capillary used in the following measurements had a mean radius of 0.0495 centimeters and a length of 16.37 centimeters.


PRINTING PASTES IN CAPILLARY TUBE VISCOMETER
FIG. 2
O From Plant - A
D From Plant - B
A From Plant - C
+ From Plant - D
Rate of Flow - cc. per sec.
STRESS

In Figure 2, the data obtained on representative samples of vat colors from four different plants are plotted. In Table I are given the values of the "yield value" and mobility for several colors as determined by this method.

Table I

Mobility and "Yield Value" of Vat Printing Colors as Determined by the Method of Bingham and Green

Sample Number	Yield Value (dynes/cm²)	Mobility (cm²/dyne sec)
1	375	0.27
2	425	0.34
3	445	0.23
4	385	0.37
5	370	0.78
8	450	0.44
9	350	0.26
10	510	0.17
12	400	0.13
13	420	0.38
14	435	0.14

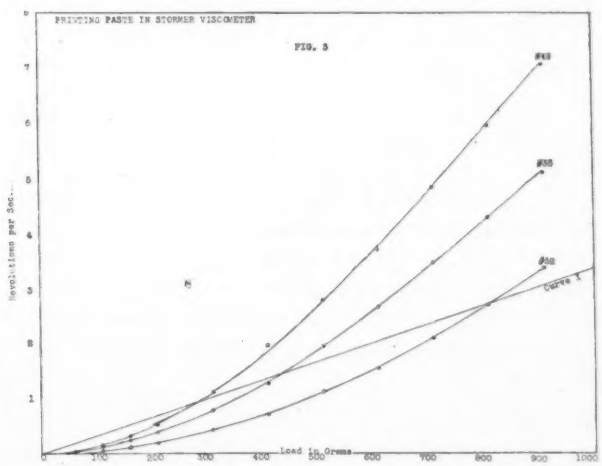
In spite of the fact that each plant uses quite different formulas and methods, the difference between the colors from plant to plant is no greater than that within the individual plants. All these colors were for use on blotch patterns. The "yield values" do not vary greatly but their determination involves a long extrapolation in a region which we are unable to study by this method. Green and Haslam[18] have shown that paints will flow at stresses which are only a small fraction of their "yield value" as determined by this method and the same is true for these colors. At low pressures the flow is much greater than would be expected for a true plastic. It appears then that this method can tell us very little about the flowing properties at low rates of shear.

Measurements with the Stormer Viscometer

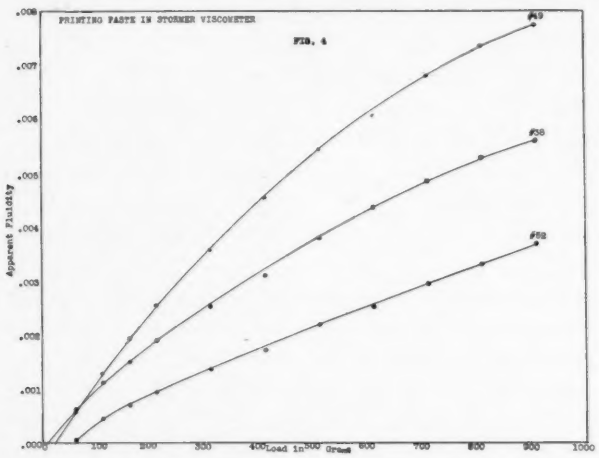
Williamson[2] has used a modified form of Stormer viscometer to study the plastic properties of paints and Draves[17] has used a similar instrument to standardize the consistency of dyestuffs. In the present study the standard Stormer instrument with the rotating cylinder was used, the only alteration being that a pan was substituted for the weight so that a wide range of weights might be used.

The sample to be studied was placed in the cup and brought to a temperature of 25° C. The cup was then raised around the cylinder and stirred by running the instrument at the highest permissible speed (usually with a load of 900 grams on the pan) until the time for 100 revolutions became constant. Other readings were then made at decreasing speeds. It was found that after this initial stirring the readings at lower speeds were quite reproducible but without this stirring the speed increased with the amount of stirring for a given load.

Figure 3 shows the type of curve obtained if we plot the speed of rotation against the load. This is analogous to the shear-stress relations illustrated in Figure 2 and it will be observed that the same type of curve is obtained.



However, in this case we are able to study the material at much lower rates of shear. Curve I shows the linear relation found for a viscous liquid, castor oil. Figure 4 shows the same data with the apparent fluidity plotted against the load, where the apparent fluidity is the ratio of speed of rotation to the load. This method of plotting shows the difference between the samples more clearly at low stresses. From these curves we see that there is a rapid increase in the apparent fluidity at low rates of shear, but that the rate of increase diminishes with increasing rate of shear.



The data obtained so far indicate that certain printing qualities are related to the apparent fluidity at low rates of shear and that other printing qualities depend upon the apparent fluidity at high rates of shear but the study has not been completed.

While this method permits the study of the flowing properties of the pastes at low rates of shear, it is not entirely satisfactory due to the errors which may result from the friction losses in the viscometer. The data will, however, be comparable.

Measurements with the MacMichael Viscometer

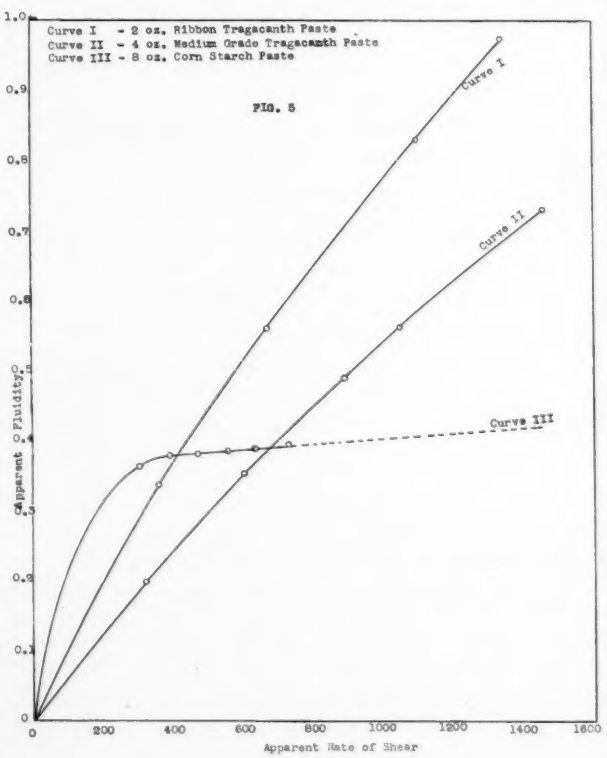
A very brief study of the applicability of the MacMichael viscometer has been made, the procedure being entirely analogous to that with the Stormer. The apparent fluidity-stress relations as shown by this instrument are the same type as with the Stormer. There is no frictional loss in this instrument and it is capable of a high degree of accuracy. It may prove of value to this investigation.

Surface Tension

The surface tension of a prepared printing paste is quite generally considered to have an important bearing on the quality of the print, particularly as regards penetration. The surface tension of a number of prepared vat colors was determined by the DuNuoy method. The values found for fourteen samples at 25° C. varied from 48 to 69 dynes per centimeter and there was no apparent correlation with the printing qualities. It seems probable that the effect of the yield value would be great enough to overcome the effect of surface tension. In regard to penetration, if the surface tension will cause the color to penetrate through the cloth then it will also cause it to pass beyond the edges of the pattern and cause "flushing". Since good penetration can be obtained without "flushing" it does not appear that the surface tension is a factor of prime importance.

Thickening Materials

A preliminary survey of the types of flow of starch and gum tragacanth pastes has shown that these pastes also are pseudoplastic and must be studied as plastic materials. The change of apparent fluidity with rate of shear as shown by the capillary tube viscometer, is shown in Figure 5. Curve I represents a two ounce per gallon ribbon tragacanth paste, Curve II a four ounce per gallon medium grade tragacanth paste, and Curve III an eight ounce per gallon corn starch paste. These curves serve to illustrate the great importance of the rate of shear on consistency measurements. At low rates of shear the order of increasing fluidity is II, I, III; at a rate of shear of about 500 the order is II, III, I; and at a high rate of shear the order is III, II, I. These examples serve to emphasize the necessity for studying the properties of these materials under widely varying conditions and this is one of the objects of this investigation.


Curve I - 2 oz. Ribbon Tragacanth Paste
Curve II - 4 oz. Medium Grade Tragacanth Paste
Curve III - 8 oz. Corn Starch Paste
FIG. 5
Curve I
Curve II
Curve III
Apparent Fluidity
Apparent Rate of Shear

Conclusions

So far, the work done on this project has been concerned chiefly with the development of tests for measuring the physical properties of the pastes involved in textile printing. The Stormer viscometer appears to be the most suitable instrument of those studied for the evaluation of consistency but it is not entirely satisfactory. It does, however, offer a fairly accurate method for the

comparison of the various pastes. Prepared vat printing pastes obtained from different sources show a marked similarity in consistency as determined by this method but it will be necessary to eliminate a number of other variables which affect the quality of the print before the effect of the consistency of the prepared color on its printing properties can be definitely stated.

It is planned to make next a study of all the various materials that are, or may be used for thickening vat dyes and to determine their relative value in the prepared printing color. It is intended to include a study of the methods of cooking, and the effect of various materials which are commonly added to the thickeners, such as alkalies, hydrosulfite, glycerine, etc., with the ultimate object of obtaining a printing color that will possess the most satisfactory qualities and give the maximum color value at minimum cost.

References

[1]Knecht and Fothergill, "The Principles and Practice of Textile Printing," 2nd edition, p. 136, Charles Griffin & Co., London.

[2]Williamson, Ind. Eng. Chem., 21, 1108 (1929).

[3]Williamson and Heckert, ibid, 23, 667 (1931).

[4]Bingham and Green, Proc. Am. Soc. Testing Materials, II, 19, 640 (1931).

[5]Bingham, J. Phys. Chem., 29, 1201 (1925).

[6]MacNider, Ind. Eng. Chem., 4, 417 (1912).

NOTICE TO JUNIOR MEMBERS

JUNIOR members considering themselves qualified for Active membership, should write the Secretary immediately, in order that the Council may act upon their names in time for proper classification in the Year Book.

The Constitution states that, "Active membership shall consist of persons who shall be not less than twenty-six years of age, and shall have had at least five years' experience as textile chemists or as chemists otherwise directly concerned with the application of dyestuffs, dyers, bleachers, or finishers.

UNEMPLOYMENT REGISTER

(Continued from page (90) 180)

yarn; woolen, worsted and union piece dyes on both ladies' and men's wear; wool, cotton, shoddy and mohair raw stock. Age 33, married, will go anywhere. References.

B-9

Experience—Hosiery dyer with fifteen years' experience on high grade silk hosiery; familiar with all types of machines. Age 43, married. Will go anywhere.

B-10

Experience—Ten years in top dyeing for fancy men's wear trade, knitting trade and sports wear; also piece dyeings on men's wear, crepes, sports flannels and tropical suitings; also several years association with commission dyeing trade doing tops, worsted skeins, cotton skeins, piece dyes, peroxide bleaching, naphthols, mohair plushes and imitation caracul cloths. Familiar with many types of machines. 38 years old, single with dependents.

B-11

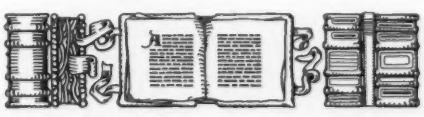
Education—B.T.C., Lowell Textile Institute, 1926.

Experience—1 year dyeing raw stock with chrome colors, 6 years dyeing hosiery on all fiber combinations and cotton, wool and merino yarns in Franklin Process machines, several years experience in garment dyeing. Age 29. Married. References.

F-1

Education—Textile Institute, Alexander Hamilton Inst., Extension work at Brown Univ., working knowledge of German.

Experience—Has had executive departmental work with all types of textiles manufacturers. Acquainted with all types of textile machinery, dyestuff application, laboratory practice, cost methods, and checking methods and processes. References.



Proceedings of the American Association of Textile Chemists and Colorists

UNEMPLOYMENT REGISTER

Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the secretary any vacancies which may occur in their businesses.—H. C. Chapin, Secretary, Lowell Textile Institute, Lowell, Mass.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive

Note. Persons who have obtained employment should notify the secretary at once. Prospective employers may file vacancies either with the secretary or the American Dyestuff Reporter.

A-2

Education—B.T.C., Lowell Textile Institute, 1932; also course in typing.

Experience—None to date, interested in quantitative analysis, experimental dyeing, color matching, dye testing and dye identification. Ability to learn quickly and will go anywhere. 23 years old, woman, single.

A-5

Education—B.T.C., Lowell Textile Institute.

Experience—Assistant chemist in carpet mill, dye tester in dye plant, research and analytical work in silk dyeing and finishing plant laboratory, plant chemist and overseer of bleaching in surgical dressing plant, assistant chemist in woolen mill. Age 29. Married.

A-B-2

Education—Lowell Evening Textile School, 1917.

Experience—Five years' experience in hosiery dyeing, full fashioned hosiery of silk and cotton and silk, also men's hosiery containing rayon, wool, cotton and celanese. Several years experience in laboratory work. Has also had experience in jig-dyeing of cotton piece goods, slub and top dyeing.

A-B-C-1

Education—Graduate Industrial Chemical Engineer, Pratt Institute—1911.

Experience—One year as plant control chemist, 4 years as laboratory chemist with gas company, 13 years as plant chemist with bleaching, dyeing and finishing plant. (Rayon and cotton piece goods). Formulated processes and put them into plant operation, 1 year as chemist and demonstrator for dyestuff company, 1 year as superintendent colorist with print works printing linen and rayon, 1 year as director of testing laboratory for national dry goods concern.

A-E-2

Education—B.T.C., Lowell Textile Institute, 1933.

Experience—Assistant instructor in chemistry, Lowell Textile Institute. Member of scholastic honorary fraternity.

A-E-1

Education—Ph.D., Univ. of Illinois, studied chemical engineering at Columbia, licensed chemical engineer, New Jersey.

Experience—10 years' experience teaching in colleges, subjects included chemical and textile subjects. Has had broad experience in industrial work including experience in testing materials, research and consulting. Will go anywhere; references.

B-1

Education—Educated and trained in chemistry and calico printing in Glasgow, Scotland.

Experience—Has been with large print works as colorist for 13 years producing first class work on cotton, rayon, wool and silk fabrics. References.

B-2

Experience—Boss dyer with one firm for 18 years, divisional supt. at print works for 1 year, in charge of processing and dyeing of cottons and rayons at large bleachery for 6 years. Prefers bleachery in East but will go anywhere. References.

B-3

Experience—Foreman piece dyer for the past 21 years. Can dye the following; celanese, rayon, cotton slacks, wool, silk and mixed fabrics. Has knowledge of finishing and laboratory work.

B-6

Education—Graduate R. I. School of Design.

Experience—5 years in bleachery, 7½ years as assistant dyer, 2 years as boss dyer and 3 years as superintendent of dyeing and finishing. Married, 33 years old. References.

B-7

Experience—Eight years as boss dyer on skeins and ribbons. Over ten years as chemist and head dyer for a large hosiery mill. Experienced on Silk, cotton, rayon and wool in skeins, ribbons, piece goods and all kinds of mixtures. Willing to go anywhere. Not afraid to work or face responsibility. Can handle help efficiently.

B-8

Education—Chemistry and Dyeing Department, Philadelphia Textile School.

Experience—Eleven years experience as chemist and boss dyer on the following: woolen, worsted and cotton

(Continued on page (89) 179)

APPLICATIONS FOR MEMBERSHIP

Active

Harry Bentley—Dyer, Linwood Lace Works, Washington, R. I. Sponsors: Richard Bayer, Frederick Mason.

John F. Fitzgerald—Chemist, U. S. Finishing Co., Providence, R. I. Sponsors: W. H. Cady, R. A. Pingree.

Arthur L. Fowler, Jr.—Chemist, American Cyanamid & Chemical Corp., Woodbridge, N. J. Sponsors: R. E. Rupp, H. C. Klipstein.

Gilbert T. Latham—Dyestuff Salesman and Demonstrator. Sponsors: A. J. Feit, H. T. Latham.

H. Davis Merion—Chemist and Superintendent, Rayon Dept., Hampton Co., Easthampton, Mass. Sponsors: E. H. Fuller, L. A. Olney.

John Miller—Dyer, Lacon Woolen Mills, Lacon, Ill. Sponsors: Elmer F. Smith, L. B. MacFarland.

Francis B. Morton—Chief Chemist, Lincoln Bleachery & Dye Works, Lonsdale, R. I. Sponsors: Alex. Morrison, L. L. Briden, E. A. Wilkinson.

C. Norris Rabold—Research Service Dept., Corn Products Refining Co., Argo, Cook County, Ill. Sponsors: H. F. Lawton, W. H. Cady.

George W. Shearon—District Manager, J. B. Ford Sales Co., Atlanta, Georgia. Sponsors: C. A. Jones, C. B. Ordway.

Clifton Kerns—Colorist, Calco Chemical Co., Bound Brook, N. J. Sponsors: R. R. Sleeper, G. A. Moran.

Joseph Corea—Dyer, Berkshire Knitting Mills, Reading, Pa. Sponsors: H. C. Bick, E. C. Knaeble.

Harold L. DeTurck—Chemist, Berkshire Knitting Mills, Reading, Pa. Sponsors: H. C. Bick, E. C. Knaeble.

Joseph H. Easley—Chemist, Rock Hill Printing & Finishing Co., Rock Hill, S. C. Sponsors: J. L. Crist, C. H. Stone.

Arthur W. Etchells—Chemist, Hellwig Silk Dyeing Co., Delaware Ave. and Comly St., Philadelphia. Sponsors: W. A. Stringfellow, E. C. Knaeble.

Irving E. Fairbrother—Dyer, Oldtown Woolen Co., Guilford, Maine. Sponsors: F. W. Sturtevant, W. C. Smith.

Burton F. Mitchell—Supt. Processing Plant, American Yarn & Processing Co., Mount Holly, N. C. Sponsors: A. H. Grimshaw, Louis A. Olney.

C. W. Nichols—Dyer, Belmont, N. C. Sponsors: J. S. Lange, H. M. Sprock.

H. D. Boswell—President, Milwaukee Dye & Bleaching Co. Sponsors: W. S. Paddock, E. F. Hempel.

Nelson W. Humbaugh—Salesman, Proctor & Gamble Co., Milwaukee, Wis. Sponsors: E. F. Hempel, W. S. Paddock.

Otto W. Leibiger—Chemist, Lyons Piece Dye Works, Paterson, N. J. Sponsors: Daniel Burchill, Marcel Beaujon.

Alfred Marsh—Colorist, Algonquin Ptg. Co., Fall River, Mass. Sponsors: T. A. McCann, James Worton.

Albert L. Mulcahey—Superintendent, Dyeing & Finishing, Shelton Looms, Shelton, Conn. Sponsors: H. H. Taylor, Duncan Ferguson.

Frank S. Pittman—Superintendent, Bradford Mills, Prattville, Ala. Sponsors: C. B. Ordway, C. A. Jones.

R. M. Ritter—Delta Finishing Co., Philadelphia, Pa. Sponsors: R. E. Sullivan, E. C. Knaeble.

John R. Senior—Chemist and Assistant Dyer, S. & M. Dye Works, Philadelphia, Pa. Sponsors: D. McGowan, Jr., W. A. Stringfellow.

Junior

Raymond C. Warner—Dyer, Farwell Bleachery, Lawrence, Mass. Sponsors: F. E. Busby, W. H. Cady.

M. H. Mettee, 3rd—Colorist, Calco Chemical Co., Bound Brook, N. J. Sponsors: R. R. Sleeper, A. B. Ulmes.

Associate

Porter H. Brown—Salesman, Tri-State Chemical Co., Chattanooga, Tenn.

Logal Wolfe Neal—Soap, glycerine, red oil and stearic acid broker, Philadelphia, Pa.

Philip S. Bolton—N. E. Representative, Clinton Co., Clinton, Iowa. Sponsors: A. H. Sampson, M. P. Graham.

Student

Glen Mortimer Kidder—Lowell Textile Institute. Sponsor, L. A. Olney.

Analytical Methods for a Textile Laboratory

The Council of the A.A.T.C.C. believing that Dr. Scott's series of articles entitled "Analytical Methods for a Textile Laboratory" might well be brought together in book form, have proceeded with its publication. The book contains 80 pages, and is of handy size for use in the laboratory. They may be obtained from the Secretary of the Association for 75 cents.

STANDARD SILK SAMPLES

There have been prepared, under the direction of the Sub-Committee on Fastness of Dyed Silk, standard dyed silk fabrics to represent four classes of fastness to washing—namely, Class I, Class II, Class III and Class IV. These standards have been carefully dyed with the dyestuffs and according to the dyeing methods recommended in the 1931 Year Book.

The A. A. T. C. C. is prepared to furnish sets of these washing standards for a nominal charge which will cover the cost of preparation. It will be possible to accurately grade the fastness by comparing it with the standards after subjection to the standard washing tests approved by this Association. All inquiries concerning these Silk Washing Standards may be addressed to the Chairman of the Research Committee.

Louis A. Olney,
Lowell Textile Institute,
Lowell, Massachusetts.

AMERICAN
DYESTUFF
REPORTER

LOUIS A. OLNEY, Sc.D.
Professor of Chemistry and Dyeing, Lowell Textile Institute
Directing Editor

NORMAN A. JOHNSON
Managing Editor

MYRON DREW REESER
Advertising Manager

Published biweekly by
HOWES PUBLISHING CO., INC.
440 Fourth Avenue, New York City

A. P. HOWES
President

M. D. REESER
Secretary

H. F. CRAWFORD
Treasurer

Subscription price: $5.00 per year; Canadian $6.80; foreign $6.00

Vol. XXIII March 26, 1934 No. 7

HONEST LABELING

IN AN effort to protect the consumer against the prevalent practice of misrepresentation of quality the Consumers Advisory Board of the National Recovery Administration has turned over to General Johnson a report made by its "Standards Unit" which included that committee's definite recommendations for a revision of the Silk Textile Code. The two principal matters with which the report is concerned are weighting and fiber identification and it is obvious that definite specifications on these subjects should be included in the code of fair competition not only for the protection of the consumer but also to protect the honest manufacturer from his unwelcome contemporary—the "chiseler."

Dr. Robert A. Brady, head of the Standards Unit, issued the following statement in connection with the report:

"In this report the Consumers Advisory Board is recommending that the silk textile industry, now operating under a code of fair competition, take immediate steps to correct certain obvious and well-known abuses in the manufacture and sale of silk goods by working out grades, labels, and content-specifying terms for the commodities produced which will inform rather than mislead the consumers, simplify rather than complicate sale, and favor the honest rather than underwrite the chiseling manufacturer or salesman.

"There can be no question that clear-cut, meaningful, and quality identifying terms and labels are the life of fair trade. Without them the language of purchase and sale is reduced to gibberish, and the "chiseler" is presented with a golden opportunity to force competition to follow a sort of commodity Gresham's Law—poor goods driving out the better. Equally serious is the fact that without such standard terms (nomenclature) and labels, the buyer is placed completely at the mercy of the seller. The ultimate consumer is the most helpless of all buyers because the least skilled in purchase, the least informed by the relevant facts, and the most confused as to the objects of buying.

"For that reason the ultimate consumer requires quality grading and informative labeling more than any other buyer. The Consumers' Advisory Board is maintaining that consumers must be protected from unfair competition. Under the NRA this is the obligation and the privilege of industry. In making its recommendations the Consumers' Advisory Board is expressing not only its interest in protecting ultimate consumers as well as all buyers, but also its desire to aid the silk industry and promote the purpose of the National Recovery Act."

The report in itself deals with existing conditions and the method of conducting research in obtaining facts concerning these conditions. An example of the type of information which the report gives is shown in the following excerpt: "Analysis of fifty 'silk' dresses, prices ranging from $2.95 to $59.50 per dress, purchased in New York City in 1931, as part of a silk research project undertaken by Dr. Pauline Beery Mack, Pennsylvania State College, and Freda Gerwin Winning of New York University, showed that the silk of three dresses only contained no mineral weighting, forty-four dresses contained more than 50 per cent weighting, two dresses contained 13 per cent and 38 per cent respectively, while one dress sold as silk was 100 per cent rayon."

Whatever one's personal feelings may be with regard to the NRA, its aims and purposes, there should be no discord amongst honest manufacturers and retailers in regard to the recommendations of the Consumers' Advisory Board. As to the feelings of the buying public it requires no stretch of the imagination to believe that they will receive such regulations with open arms. There has been considerable agitation in consumer buying circles in regard to the weighting of textiles—perhaps most of the ill feeling has been caused by the consumer receiving weighted goods when under the impression that the goods were composed of pure fiber. If they know definitely in advance what they are buying they will know what to expect. Weighting in itself in many cases is an advantage to silk and the buying public should also be informed of this fact.

William R. Cathcart

Dr. William R. Cathcart, technical director of the Corn Products Refining Co., died after a brief illness in a hospital at Asheville, N. C., on February 22nd. His home was in Leonia, N. J. and he was visiting in the South at the time of his death. He was 65 years of age.

He had been with the Corn Products Refining Co., for eighteen years. He was widely known as a consulting chemical engineer. He is survived by his widow, two sons, Nobel A. Cathcart of New York and Richard C. Cathcart, a student at Yale and one daughter, Mrs. Jonathan Daniels of Raleigh, N. C.

St. Petersburg Meeting of American Chemical Society

Division of Cellulose Chemistry

St. Petersburg, Fla., March 25 to 30, 1934

C. E. Curran, Chairman

W. O. Kenyon, Secretary

ABSTRACTS OF PAPERS TO BE PRESENTED

1. Composition of woods found in the Miocene sands of California. R. L. Mitchell and Geo. J. Ritter.

Lignin constitutes the major portion of the old wood; extractives have practically disappeared. The cellulose is exceedingly low in some of the woods and requires a modification of the method ordinarily used for its determination.

2. Experiments in the utilization of Sawdust as a plastic material. E. Bateman and J. P. Hohf.

This paper deals with experiments on plasticizing wood in an effort to utilize large amounts of sawdust and similar wood waste.

Pretreatment with chlorine, over a wide range of concentrations, will render sawdust plastic under heat and pressure.

There is a minimum and a maximum concentration of chlorine with which plastic mixtures are obtained. Attempts to waterproof these products were only partly successful.

Phenols, aldehydes, and various hydrocarbons were found to react with sawdust in the presence of dilute HCl with the formation of products much improved in appearance, strength and molding properties. These products were somewhat corrosive to metals and etched mold surfaces.

Preliminary digestion of these mixtures, followed by hot-water washing, removed the hygroscopic water-soluble products of the reactions and most of the acid. This gave improved products which were better in color and water resistance and having moduli of rupture and elasticity about equal to the spruces. However, these were still sufficiently acid to slightly etch the highly polished surfaces of the molds.

Subsequent experiments have been made in which the preliminary digestion was carried out without the addition of any acid catalyst whatsoever, the excess "plasticizers" removed, and the material pressed. These last have better strength and molding characteristics and are much "tougher" than those subjected to acid digestion.

This work is being continued.

3. Chemical purification of Ramie. P. M. Horton and G. L. Carter.

Attempts to lower the cost of the removal of the bark and the gums from ramie fiber by a method previously worked out by the authors have resulted in the substitution of sodium hydroxide for the combination of sodium sulfite and ammonia in the digestion of the fiber. In order to produce a fiber of unimpaired strength using sodium hydroxide it has been found that certain precautions are necessary in regard to the exposure of the air of the fiber saturated with hot alkaline spent digestion liquor.

Experimental data are given in which a comparison is made between the two methods of digesting in regard to the age of the plants from which the fiber was obtained, the strength of the fiber at several different points during the process, the bleach consumption, and the yield of fiber. These comparisons were made on samples of ramie fiber that were stripped from stalks obtained from a plot of ramie one year old. All stripping was done by hand.

4. The removal by cotton of sulfuric acid from solutions in organic acids. T. F. Murray, Jr., W. O. Kenyon, and H. LeB. Gray.

The removal of sulfuric acid by cotton from solutions in acetic acid of varying concentration with varying sulfuric acid to cotton ratios has been followed.

By plotting the sulfuric acid removed against equilibrium concentrations, a curve has been obtained showing a maximum of removal. When the cottons thus treated are washed with water, a portion of the sulfuric acid remains in the cellulose. Less extensive studies have been carried out using solutions of sulfuric acid in propionic acid and in n-butyric acid. The removal of sulfuric from acetic acid solutions has been found to decrease with increasing temperatures.

5. The chemistry of wood. V. Water Soluble Polysaccharide of European Larch. Floyd C. Peterson, Matthew Maughan, and Louis E. Wise.

Complete hydrolysis of the water soluble polysaccharide of European larch (Larix decidua Mill.) gives rise to yields of 12.2 per cent arabinose and 81.7 per cent galactose, thus indicating it to be an arabo galactan identical with that obtained by Wise and Peterson from Western American larch and by Wise, Hamer and Peterson from Eastern American larch. The arabinose was identified as the l-variety through the rotation of its diphenylhydrazone. The presence of galactose was established by oxidation methods which led to the formation of mucic acid identified by melting point determintaions. Qualitative tests indicated that mannose was not present in the hydrolysis products of the polysaccharide. Methoxy and

(Continued on page 190)

ANALYSIS OF WOOL-COTTON TEXTILES

(Continued from page 160)

IV. Removal of Cotton From Mixtures With Wool

One published method for the removal of cotton from mixtures with wool calls for treatment of the specimen with a solution of sulfuric acid prepared by mixing 80 ml of the concentrated laboratory reagent with 25 ml of water and weighing the wool residue after it is washed and dried.[9] This method may be applied to the fiber mixture free from sizing and finishing materials or, if these materials are removed by the sulfuric-acid solution, it may be applied directly to a specimen of the original material. A similar method for separating cotton and rayon from wool is recommended by Krais and Markert.[10]

Though cotton is readily dissolved by the acid, it was thought necessary to determine whether the wool is recovered quantitatively. Skeins of purified wool were

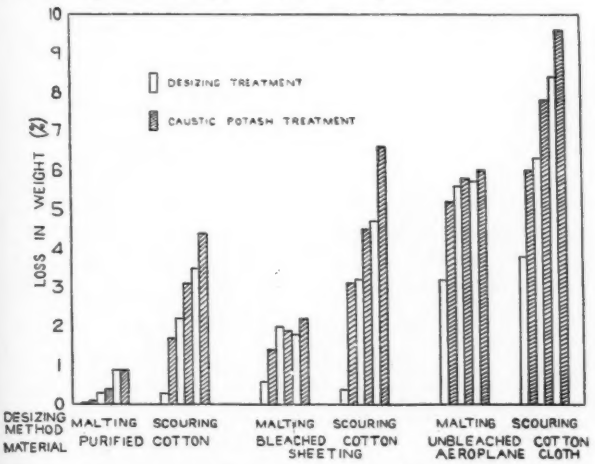


Fig. 1.—Change in weight of cotton specimens subjected to desizing and caustic treatments.
(The loss in weight of a specimen after desizing, desizing and treatment with caustic potash, and repetition of these treatments 1 and 2 times shown.)

dried, weighed, and then immersed for 15 minutes in 80 to 100 times their weight of sulfuric-acid solution at room temperature. The wool was then washed until the wash water gave no test for acid with methyl red indicator or for sulfate with barium-chloride solution. It was finally dried and weighed.

Table 1—Changes in Weight of Cleaned Wool Treated with Sulfuric Acid

Sample No.	Treatment	Gain in weight	Loss in weight when corrected for absorbed SO_4
		Percent	Percent
1	Washed with water at room temperature until water gave no test for acid or SO_4	7.0	.....
2		5.1	.....
3		5.7	.....
4		6.8	.....
5		6.5	.....
6		6.2	.....
7		5.5	.....
8		7.8	2.5
9		7.4	2.3
10		8.4	3.0
11		8.7	2.6
12		8.8	2.4
13	Washed and then extracted[1] with water for 10 hours	5.9	.....
14	Same as 13, then extracted with 0.2 percent NH_4OH, followed by water	5.7	.....
15	Same as 14, followed successively with soap solution, an alcohol, and an ether rinse	5.4	.....
16	Immersed for 16 hours in dilute NH_4OH and extracted 10 hours with water	6.9	.....
17	Immersed for 16 hours in 1 percent sodium-carbonate solution and extracted 10 hours with water	6.0	.....
18	Immersed for 16 hours in 1 per cent triethanolamine and extracted 10 hours with water.	9.9	.....
19		8.9	.....
20		7.6	.....
21	Immersed for 16 hours in 2 percent triethanolamine and extracted 10 hours with water.	7.4	.....

[1] Each extraction was made at room temperature in a modified soxhlet apparatus, the extraction chamber filling with fresh liquid after each discharge, except with the ether and alcohol—these were made with the regular soxhlet extractor in the usual manner.

It is seen from the results given in Table 1, for samples numbered 1 to 12, that the wool weighs from 5 to 8 per cent more after this treatment. The amount of sulfate left in the wool was determined for samples numbered 8 to 12 by dissolving the yarn in a boiling 5-per cent solution of potassium hydroxide, cooling, acidifying with hydrochloric acid, and filtering; the filtrate was heated and the sulfate ion precipitated with barium chloride; the precipitate filtered, washed, ignited, and weighed. After allowing for the sulfate, the weight of the wool is 2 to 3 per cent less than that of the original, cleaned, untreated sample, as shown in the last column of the table. It appears that there are at least two sources of error inherent in the method. One, the result of absorption and retention of acid by the wool; the other, the result of partial decomposition of the wool in the acid treatment.

An effort was made to eliminate the absorbed sulfate by various treatments without serious decomposition of the wool itself, but none was successful. The results of these experiments are also given in Table 1, samples 13 to 21. They show that the sulfuric-acid method as commonly applied to the quantitative separation of wool and cotton or rayon gives inaccurate results because a proper correction is not made for the absorbed acid which is not removed from the wool. The results for wool may be high by as much as 8 per cent of the amount actually present.

A modification of the commercial process of carbonization with aluminum chloride has been adopted by some industrial laboratories for the removal of cotton from mixtures with wool. The laboratory method first brought to our attention included the following steps.

1. Boil about 1 g of the fiber mixture for 10 minutes in a 5-per cent aqueous solution of aluminum chloride.

2. Remove the fibers from the aluminum chloride solution without squeezing and bake them for 2 hours on a watch glass in an oven at a temperature of 100° to 105° C.

3. Rub the fibers well between the hands over a piece of smooth glazed paper to break up the hydrated cellulose and to separate as much of it as possible from the wool.

4. Collect the hydrated cellulose in a flask and shake it with an aqueous solution of hydrochloric acid. Let the

suspension stand for a few minutes and then wash it through a No. 100 sieve with tap water. The hydrated cellulose passes through and any wool fibers mixed with the cellulose will remain on the sieve. Collect the wool fibers and wash them with 10 per cent hydrochloric-acid solution. Filter through the sieve and rinse well with tap water.

Table 2—Changes in Weight of Cleaned Wool Treated by the Different Steps of the Aluminum-Chloride Carbonization Method[1]

Sample No.	Treatment	Change in weight
		Percent
20		—0.6
21		— .5
22	Baked at 100° to 105° C.; washed with 3.5 percent HCl, 2	— .5
23	percent Na_2CO_3, and water	— .6
24		— .8
25	Baked at 105° to 110° C.; washed with 3.5 percent HCl, 2	— .7
26	percent Na_2CO_3, and water	— .5
27		2.3
28	Baked at 105° to 110° C.; washed with water only	1.8
29		2.4
30		.1
31	Treated with 3.5 percent HCl and washed	.0
32		.0
33		— .2
34	Baked at 105° to 110° C.; washed with 3.5 percent HCl,	— .3
35	and water	.0

[1] Values are in percentages of the oven-dried wool and represent increases except where preceded by a minus sign.

5. Dry or condition the wool fibers and weigh them.

Purified wool was subjected to treatment by this method and the change in weight determined. The results are recorded in Table 2, Samples 20 to 24. Modifications of the method were tried to determine whether any of the steps could be omitted without causing greater changes in the weight of cleaned wool treated. The results on Samples 25 and 26 shows that the baking temperature may be raised to 105° to 110° C. so that the same oven used by laboratories for drying fibers to constant weight at this temperature may also be used for baking the specimen for carbonization. Washing the wool fibers with hydrochloric-acid solution is necessary for the removal of decomposition products of the aluminum salt which may otherwise be retained by the wool fibers, producing errors in the weight for wool. This is illustrated by the results obtained on Samples 27 to 29, which were not washed with acid. Wool fibers given the treatment received by this group of samples yield a considerable ash on ignition. It seems, however, that the treatment with 2 per cent sodium-carbonate solution may be successfully omitted, Samples 30 to 32. It is probable that this treatment was introduced with the object of neutralizing any hydrochloric acid that might be held by the wool so that it could be more readily removed. Wool treated at room temperature with approximately 3.5 per cent solution of hydrochloric acid (prepared by diluting 1 part of the concentrated laboratory reagent acid (35 to 36 per cent) with 9 parts of distilled water), to remove the decomposition products of aluminum chloride, can readily be washed free of acid with practically no change in weight of the wool treated. This is shown by the results obtained on Samples 30 to 32.

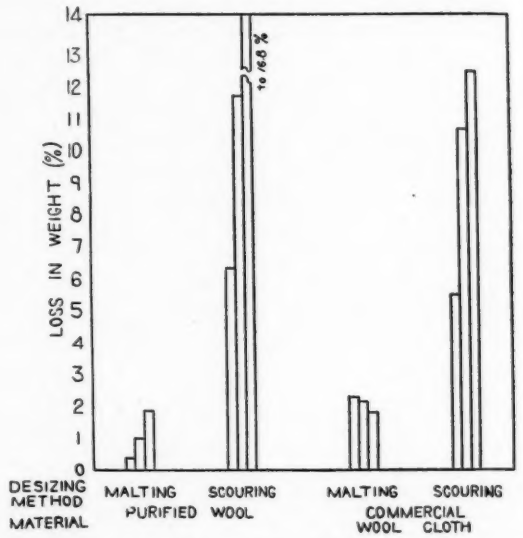


Fig. 2.—Change in weight of wool specimens subjected to desizing treatments. (The change in weight of a specimen after desizing 1, 2, and 3 times is shown.)

These results show that the aluminum-chloride carbonization method for removing cotton from wool, as given above, produces changes in weight of purified wool of less than 1 per cent of the weight of the wool treated; that the method may be modified by baking at 105° to 110° C. instead of 100° to 105° C. to suit the convenience of the analyst; and that the treatment of the wool residue with 2 per cent sodium-carbonate solution may be omitted.

No difficulty was experienced in collecting the wool fibers during the rubbing-out process to remove the carbonized cellulose. With the aid of a No. 40 wire sieve placed between the hands and glazed paper the dry wool and cotton can be easily separated and the wool obtained in the form of a tangled mass or mat. Washing the cellulose with hydrochloric acid as described in the first part of step 4 can be omitted. It was further observed that when wet wool fibers are placed upon a No. 100 sieve, some of the ends of the fibers extend to the opposite side and become quite firmly held in the meshes. This screen is not considered satisfactory. A small Büchner funnel or gooch crucible was found very convenient and effective for holding the wool fibers while washing them to remove aluminum salts.

With the modifications suggested, the method is convenient and applicable for the accurate determination of wool in mixtures with cotton and regenerated cellulose rayons, but not with cellulose acetate. The regenerated cellulose rayons, like cotton, are carbonized by the treatment. Many of the common sizing and finishing materials are likewise removed.

V. Removal of Wool From Mixtures With Cotton

The fact that wool is readily dissolved by hot caustic solution has been the basis of quantitative methods for separating wool from cotton. The residual cotton is weighed and the amount of wool is estimated from this weight and that of the untreated specimen. It has been customary to make an arbitrary correction on the weight of cotton residue obtained to allow for natural non-cellulosic materials likely to be present in it. It seems preferable for purposes of analysis to consider "cotton" and "cotton cellulose" as synonymous terms. Any allowances that may be desired may conveniently be based upon this weight.

Specimens of purified cotton—some of it in the form of yarns and some as unspun fibers—were subjected to the treatment for removal of wool; that is, immersion for 15 minutes in a boiling 5 per cent solution of potassium hydroxide. Care was taken to keep the specimen submerged and increased concentration of the solution by evaporation was avoided by use of a reflux condenser. The cotton was then rinsed with water, then with 1 per cent aqueous solution of acetic acid and again with water until neutral to methyl-red indicator. Figure 1 shows the loss in weight of purified cotton, unbleached and bleached cotton when subjected to desizing treatments followed by a boiling caustic-potash solution to remove wool. It was found that purified cotton cellulose lost no appreciable weight when subjected to a malting followed by a caustic-potash treatment. Bleached and unbleached cotton lost much more. This can only be accounted for by the presence of materials other than cotton cellulose. The amount lost indicates the magnitude of error for wool when it is determined by difference.

When cotton cellulose only is to be determined, a preliminary extraction and malting treatment to remove size and finishing materials may not be necessary; the results show, however, that a specimen used for determination of size and finishing materials by the malting method may also be used for the determination of cotton cellulose.

VI. Proposed Method for the Analysis of Wool-Cotton Mixtures

Wool and cotton fibers may be separated mechanically and determined with the aid of a microscope and proper auxiliary equipment. [11, 12] Such separation is easily made if the wool and cotton are in separate yarns in a fabric, but is tedious and less reliable if the fibers are spun together into yarns. If a method of counting the fibers is used, computations must be made to take into account the relative diameters and densities of wool and cotton fibers if the results are to be expressed on either a volume or weight percentage basis. The following method of chemical analysis is proposed for use where mechanical methods for separation of the fibers are inconvenient or impractical.

1. Drying and Weighing

Dry 5 g of the material in an oven maintained at 105 to 110° C. (221 to 230° F) to constancy ± 0.1 per cent of the weight of the specimen. A satisfactory procedure is to dry the specimen for 1½ hours, remove it from the oven, place it while warm in a tared weighing bottle, cover, cool in a desiccator, and weigh; return the specimen to the oven and repeat the drying and weighing until constant weight is attained. Let the weight of the oven-dried sample be called A.

2. Total Sizing, Finishing, and Other Nonfibrous Materials

(a) The purpose of this procedure is to remove nonfibrous natural constituents and materials added by the manufacturer, such as starch, china clay, soap, some waxes, and some non-drying oils. However, general directions for the removal of all substances which may be present cannot be given. When it is necessary to modify the procedure in order to remove nonfibrous constituents completely, the analyst should make certain that purified fibers do not lose weight, or are not made susceptible to loss when analyzed for fiber content according to the modified procedure.

(b) Extract the dried specimen from 1 in a soxhlet apparatus for 2 hours with carbon tetrachloride. Allow the specimen to dry and then wash it by alternate immersion in hot distilled water and by squeezing.

(c) Immerse the specimen in a 0.5-per cent aqueous solution of a starch-hydrolyzing enzyme at 50° C. (122° F), squeeze the specimen while it is immersed, then remove and squeeze it again.[13] This procedure is repeated with the same solution for a total of three times to saturate the fibers. The enzyme solution is then maintained at 70 ± 1° C. (158° F.) and the specimen kept immersed in it for a period of 15 minutes. Rinse the specimen 12 times in fresh portions of hot distilled water, squeeze it after each rinse, and dry it to constant weight as before. This gives the weight of dry fiber, called B. The percentage of sizing, finishing, and other nonfibrous materials in terms of the weight of the oven-dried specimen is $100\frac{A-B}{A}$. Care must be taken at all times not to wash away any fibers.

3. Determination of Cotton Cellulose

Place the specimen from 2 (c) in a boiling 5-per cent aqueous solution of potassium hydroxide[14] (previously boiled to remove dissolved air) for 10 minutes; sufficient solution is taken to cover the specimen continually. Decant or filter the solution and rinse the cotton residue with hot distilled water, then with a 5-per cent aqueous solution of acetic acid, and finally with water until the rinse water is neutral to blue litmus paper. The residue is dried and weighed, giving weight C. This is the weight of dry cotton cellulose in the specimen. Then the percentage of cotton in the dried specimen is $100\frac{C}{A}$.

4. Determination of Wool

(a) This method is applicable to the determination of wool in mixture with cotton, regenerated cellulose rayons,

or both. It is not applicable to mixtures containing cellulose acetate or silk.

(*b*) Treat a specimen of the material as described under 1, 2 (*b*), and 2 (*c*), but omit the weighing under 2 (*c*). Immerse the specimen from 2 (*c*) for 10 minutes in a boiling solution of aluminu chloride prepared by dissolving 9 g of the hydrated salt ($AlCl_3 6H_2O$) in 100 ml of water. Remove the specimen from the solution; allow the excess liquid to drain or the specimen may be lightly squeezed. Heat it at 105° to 110° C. (221° to 230° F.) until the cotton has become brown and brittle—2 hours is usually sufficient. Hold the specimen over a piece of glazed paper and work it with the hands in order to pulverize the carbonized cellulose and separate it from the wool. By suitable manipulation all of the wool is obtained as a mat and the cellulose is left on the paper, mostly in the form of a powder. The separation is facilitated by the use of a wire screen, approximately No. 40, between the hands and the glazed paper. Place the wool in a beaker of warm water, agitate it thoroughly to wet it, and form a mat of the coarser fibers in a gooch crucible or Bücher funnel; apply gentle suction and pour the remaining fibers and filtrate on the pad. Remove the fibers and agitate them with a solution of hydrochloric acid prepared by diluting 1 part of the concentrated laboratory acid with 9 parts of distilled water. Repeat the operation using several portions of water instead of acid until the wool is freed from powdered cellulose and the wash water is free from chlorides. The wool is dried to constant weight, called *D*. Then the percentage of wool in the specimen is $100\frac{D}{A}$.

A less reliable value for wool may be obtained by difference after the removal of wool according to paragraph 3, by use of the formula $100\frac{B-C}{A}$; similarly, cotton or cellulosic material may be determined by the formula $100\frac{B-D}{A}$.

VII. Analyses of Mixtures of Known Composition by the Proposed Method

Table 3 gives the results of analyses to determine the amount of wool in known mixtures of purified cotton and wool. The samples were prepared in the laboratory by drying purified wool and cotton, some as yarns and others as loose fibers, and accurately weighing and then mixing them. They were then analyzed according to the method described in Section VI.

Other samples, prepared similarly, were analyzed for cotton content by the method recommended for cotton by two analysts working independently, one inexperienced in its use. The results of these analyses are given in Table 4.

When mixtures to be analyzed consist of comparatively pure cotton and wool, either one of these may be determined directly as described, and the other by difference, with a fair degree of accuracy. In actual practice, however, fabrics may contain other materials which may introduce an error in the figure for fiber content obtained by difference. This error is usually eliminated if the fiber which is to be determined is weighed directly.

Table 3—Analyses of Prepared Wool-Cotton Mixtures for Wool Content

Wool Content (Per Cent)			
Present	*Found*	*Present*	*Found*
87.9	88.2	49.4	49.1
83.8	83.8	40.1	40.0
78.3	79.0	29.4	29.1
72.8	72.3	20.0	20.3
69.4	69.7	9.9	9.9
57.8	57.7	5.3	5.3

Table 4—Analyses of Wool-Cotton Mixtures for Cotton Content

	Cotton Content (Per Cent)	
Analyst	*Present*	*Found*
G	53.0	52.6
	55.4	55.1
	80.1	79.5
	80.5	80.0
	19.8	19.5
	23.6	23.4
J	48.3	47.3
	49.3	48.9
	18.0	18.0
	18.5	18.4
	85.4	85.2
	83.8	83.6

It is not always required that sizing and finishing materials be determined. The aluminum-chloride carbonization method for determining wool and the potassium-hydroxide method for determining cotton may be applied directly to specimens of the original mixture provided extraneous materials are removed by the treatments.

Although the fibers used in these tests did not contain size, they were given the treatment recommended for its removal. Therefore, the results given include the possible error produced. The method gives the amount of cotton and wool in mixtures of these fibers to within 1 per cent of the total weight of the fiber present.

Literature Cited

[1] Statement by the Commission, Trade Practice Conference. Knit Underwear Industry. Mimeographed. July 7, 1930. Federal Trade Commission, Washington, D. C.

[2] CS39-32. Wool and Part-Wool Blankets. Government Printing Office, Washington, D. C., price 5 cents.

[3] A.S.T.M. D276-31T. Tentative Methods for Identification of Textile Fibers and Their Quantitative Determination in Mixed Goods. Proc. Am. Soc. Testing Materials, vol. 30, part I, p. 1027, 1931.

[4] U.S.G.M.S. No. 345a. General Specification for Textile Materials (Methods of Physical and Chemical Tests). 1929. Government Printing Office, Washington, D. C. Superseded by F. S. No. CCC-T-191, Textiles; Test Methods. Government Printing Office, Washington, D. C.

[5] Tentative Method for Determination of Total Sizing and Finishing Materials in Textiles. 1931 Year Book Am. Assoc. Textile Chemists and Colorists, pp. 136-137. Howes Publishing Co., New York.

[6] D. A. Clibbens and A. Geake, The Determination of Total Size or Filling in Cotton Goods. Jour. Textile Inst., vol. 22, p. T465, October 1931.

[7] A. B. Corey and H. Le B. Gray, Notes on the Preparation of Standard Cellulose. Ind. Eng. Chem., vol. 16, p. 853, August 1924.

[8] R. T. Mease, Adsorption of Alcohol by Fibrous Materials. Ind. Eng. Chem., Anal. Ed., vol. 5, p. 317, September 15, 1933.

[9] Roger Castle Griffin, Technical Methods of Analysis, p. 506, 2nd ed. 1927. McGraw-Hill Book Co., Inc., New York.

[10] F. Krais and H. Markert, Quantitative Determination of Cotton, Wool, Silk, and Artificial Silks in Mixed Textiles. Jour. Textile Inst., vol. 23, p. 214, August 1932.

[11] Edward R. Schwarz, Microscope is valuable asset to textile manufacturer and finisher. Textile World, vol. 80, p. 770, Aug. 29, 1931.

[12] Heermann, Paul, und Herzog, Alvis, Mikroskopische und Mechanischtechniche Textiluntersuchungen, p. 216, 3d ed., 1931. Julius Springer, Berlin.

[13] The effectiveness of the hydrolytic action of the enzyme should always be tested when in doubt. This may be done by treating fabric or yarn, known to contain starch sizing, with the enzyme solution according to the method prescribed and then testing for starch with iodine. This may be done by placing the fibers in a straw-colored aqueous solution of iodine. The fibers should not be blue after 5 minutes immersion.

[14] Although potassium hydroxide is preferred for critical work, sodium hydroxide is probably satisfactory for ordinary purposes.

Editor's Note

This method for the analysis of wool-cotton textiles was published as research paper No. 635 in the January, 1934, edition of the Bureau of Standards Journal of Research. This method proposed by Mease and Jessup is submitted to the readers of the American Dyestuff Reporter, particularly members of the A. A. T. C. C. for their consideration. The authors and the Bureau of Standards will welcome any criticisms of this method or any suggested modifications which any of our readers may believe will prove constructive. It is suggested, however, that any such criticism be forwarded through the editor of the American Dyestuff Reporter.

Inocyl Dyestuffs

The Geigy Company has released a circular on Inocyl dyestuffs which are said to be particularly adapted to the garment dyeing industry because of their ability to dye evenly, it is claimed on wool, silk, cotton, viscose and acetate silk. It is further claimed that the modern hat material consisting of ramie, hemp and cellophane will also be dyed very evenly and consistently. It is said that formerly it was necessary to use two of three dyestuffs to obtain the same results.

A circular describing the method of dyeing and showing sample swatches may be obtained on request.

OPEN FORUM

Readers are referred to page 127 of the February 26th issue of the AMERICAN DYESTUFF REPORTER which contains an explanation of the method under which this column will be conducted.

1—Will you kindly advise use as to where we can secure information relative to treating cotton yarns with some solution similar to that used in producing acetate rayon, so that the cotton so treated, will be susceptible to dyestuffs used on acetate rayon?—**U. S. L. C. M.**

2—I understand that the indigisol dyes are being used in wool dyeing. Can you give me any information in regard to the method of application and their fastness properties?—**P. V. I.**

3—How would you test the fastness of dyes, to be used in worsted bathing suits, to sea water?—**H. R. W.**

4—Potassium permanganate has at all times been used in small amounts by the textile industry for certain processes of bleaching and dyeing. Various manufacturers of this product would like to know whether or not its limited used in various textile processes is due mostly to its cost, or because other bleaching agents are more suitable. Also, if its use could be extended beyond the process of bleaching if its cost was reduced somewhat.—**Chemical Manufacturer.**

NEW PATENTS

Abstracted by S. O. C. M. A.

Manufacture of Nitro-Cellulose. (Consists in treating wood pulp with soda lye and carbon-bisulfide, forming the paste into pellets, and immersing in a hardening solution, then nitrating said pellets. A continuation in part of application Ser. No. 348,368, filed 3/19/29.) Ernest Tschudin, Reinach, near Basel, Switzerland, No. 1,945,-101, 1/30/34.

Production of Pyranthrone Dyestuffs. (Suitable for dyeing textile fibers, especially cotton, various shades of brown; comprises subjecting pyranthrone to the action of sulfuryl chloride in the presence of iodine and of an aromatic nitro compound, removing any insoluble chloropyranthrone which may be present in the reaction mass; a continuation in part of application, Serial No. 228,798, filed 10/25/27.) Wilfred M. Murch, Hamburg, N. Y., assignor to National Aniline and Chemical Co., N. Y., N. Y., No. 1,945,405, 1/30/34.

Dyestuff Preparations. (For example, preparations of 6.6'-diethoxythioindigo containing only one-half mol of copper sulfide calculated upon the quantity of dry pure shade.) Alfred Hagenbocker and Rudolf Brune, Frankdyestuff; claimed to accelerate color fixation and intensify fort-on-the-Main-Hoechst, Ger., assignors to General Aniline Works, Inc., N. Y., N. Y., No. 1,945,484, 1/30/34.

(Continued on next page)

Meeting of Am. Chem. Society

(Continued from page 184)

uronic anhydride groups could not be detected by qualitative or quantitative methods.

Aqueous solutions of the polysaccharide were electrodialyzed using the apparatus of Holmes and Elder. By such means, an ash removal of 92.6 per cent resulted. Close agreement of the values for rotation, reduction of Fehling's solution, furfural and Bergmann iodine number before and after dialysis serves to further substantiate previous claims relative to the homogenity of the polysaccharide.

The value of Bergmann's iodine number as a measure of the state of aggregation is discussed.

A summary of the analytical data for all three species of larch is included for the purpose of comparison. It would appear that this polysaccharide is not limited to any particular member of the larch family.

6. Chemical nature of dyestuffs in pine wood pulps.[1] G. M. Kuettel, C. E. Curran, and M. W. Bray.

An investigation of the several possible sources of dyestuffs in pine wood sulfate pulps has definitely linked these coloring materials to the phlobatannins and their condensation or oxidation products, the phlobaphenes. Other possible sources, of coloring material, such as the flavones (which were allied to and accompany certain phlobatannins) lignin and its degradation products, the possible formation of sulfur dyes in preparing the pulp, the yellowing action of alkalies on carbohydrates accompanying cellulose, or the iron content of the cooking liquors, are shown to have only a secondary influence in producing color in pine sulfate pulps and in rendering such pulps difficult to bleach. A survey of the literature leads to the conclusion that the same class of substances —the phlobatannins derivatives—are also probably responsible for the reddening of sulfite pulps.

[1]This paper is based upon a thesis submitted by Glen M. Kuettel to the Faculty of the Graduate School of the University of Wisconsin in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

NEW PATENTS

(*Continued from preceding page*)

Preparation of Sulfur Dyes. (Comprises the step of thionating by means of sodium polysulfide para-hydroxyphenyl-beta-naphthylamine in an aqueous solution of the mono-ethyl-ether of ethylene glycol.) Herbert A. Lubs and George C. Strouse, Wilmington, Del., assignors to E. I. du Pont de Nemours & Co., Wilmington, Del., No. 1,944,250, 1/23/24.

Aliphatic Amine Sulfonic Acid Containing Eight or More Carbon Atoms. (More specifically, the sodium salt of N-heptadecyl-ethyl-amino-beta-sulfonic acid; suitable as auxiliary products in the textile industry as softening, purifying, frothing, wetting, washing and dispersing agents and in facilitating even dyeing.) Karl Ott, Leverkusen-on-the-Rhine, Winfrid Hentrich, Erlangen, and Helmut Keppler, Cologne-on-the-Rhine, Ger., assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Ger., No. 1,944,300, 1/23/24.

Phosphoric Acid Esters. (Of glycol ethers, particularly suitable as gelatinizers and softeners for nitro- and acetyl-cellulose as well as for cellulose esters and ethers.) Curt Schonburg, Bitterfeld, Ger., assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Ger., No. 1,944,530, 1/23/34.

Azo Dyestuffs and Fiber Dyed Therewith. (New azo dyestuffs yielding various shades, obtained by coupling a suitable diazo-compound with an arylide of a 6-alkoxy-2.3-hydroxynaphthoic acid and produced in substance or on the fiber or on any of the usual substrata adapted for the production of lakes.) Arthur Zitscher, Offenbach-on-the-Main, Heinrich Morschel, Cologne-Deutz, and Wilhelm Luce, Hofheim-on-the-Taunus, Ger., assignors to General Aniline Works, N. Y., N. Y., No. 1,944,539, 1/23/34.

Manufacture of Azo Dyestuffs. (For instance, by subjecting a monoazo-compound obtained from diazotized metanilic acid and diethyl-meta-toluidine to a nitrating operation; yield on cellulose ester fiber, particularly acetate silk, reddish-orange shades of good fastness.) Ernst Hug, Neu-Allschwill, near Basel, and Max Muller, Basel, Switzerland, assignors to Durand & Huguenin S.A., Basel, Switzerland, No. 1,944,645, 1/23/34.

Vat Dyestuffs of the Anthraquinone-Acridone Series and a Process of Preparing Them. (New, clear yellowish-green to greenish-blue or violet vat dyestuffs of good fastness properties which are derived from 4- or 5-amino-anthraquinone-2.1-acridone.) Georg Kranzlein, Heinrich Vollmann, and Hermann Boedeker, Frankfort-on-the-Main-Hochst, and Hans Becker, Hofheim in Taunus, Ger., assignors to General Aniline Wks., Inc., N. Y., N. Y., No. 1,944,986, 1/30/34.

CLASSIFIED

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED—Assistant superintendent or foreman finishing, folding, packing, rayons· Celanese, cottons plain or prints, piece goods. American born, Lowell, Mass. 50 years of age. Practical experience. Mr. Superintendent, is your plant getting its share of crepes and taffeta? Understand a unique method not patented. I claim that I could introduce several important ideas not generally known that will give better finishes for less money. Write for details. Henry F. Carr, North Billerica, Mass. R. F. D. No. 1.